PARTS OF THE ORIGINAL DOCUMENT

ARE OF POOR REPRODUCTIVE QUALITY

CERTAINES PARTIES DU DOCUMENT ORIGINAL

SONT DE PIÈTRE QUALITÉ DE REPRODUCTION

Hydro-Québec Development Plan 1987-1989, Horizon 1996

SUMMARY

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Introduction

In this development plan, Hydro-Québec presents the results of the review conducted over the last few years to clarify the company's orientations, objectives and strategies. The plan also acquaints the shareholder and principal partners of Hydro-Québec with the scope of its development prospects. This should facilitate expressions of opinion and a general discussion of the activities and the collaboration that will make the best use of the advantages that hydroelectricity offers Québec.

As a public utility, Hydro-Québec must satisfy the electricity needs of all Québec at the best terms. A fair balance must be sought between quality of service, rate levels and rate stability. Furthermore, Hydro-Québec must assume major responsibilities in economic development. To do so, it must actively seek profitable development opportunities for all electricity markets and the optimization of the advantages of activities associated with the generation and marketing of electricity.

This plan presents a set of strategies that will allow the exploitation of hydroelectricity by the dynamic development of Québec and external markets and enable the reconstitution of the financial margin of maneuver the company had until the early 1980s. This financial margin for maneuver is necessary to ensure rate stability and respect for the minimum financial criteria because it allows to the company to absorb the vagaries of the economic and energy environment and implement certain cost-reduction strategies to allow products to be offered at competitive prices on both Québec and export markets.

Chapter 1

Transitional Period

Summary of Hydro-Québec's short-term strategies and long-term orientations.

Review of Strategies and Orientations of Previous Plans

Short-term Strategy

Actions on financial commitments

- Make the investments for commissionings until 1985 and postpone construction of additional generating capacity.

Actions on Revenues

- Increase sales of electricity by a dynamic marketing effort on domestic and external markets.

Actions on Expenses

- Cut operating expenses.

Arbitrage to Optimize the Financial Situation in the Long Term

- Limit rate increases to encourage market penetration
  - by accepting a short-term reduction in net income
  - while assuring respect for essential financial criteria:
    - interest coverage of 1.00
    - capitalization ratio of 25%.

Long-term Orientation

Fundamental Orientation

Provide electricity to Québec at the best conditions, optimize the comparative advantage that hydroelectricity constitutes for Québec and diversify its activities into fields connected with or related to power and energy.

Development Orientations

- Québec marketing that focuses on customer satisfaction, based on a pricing policy that maximizes the comparative advantage of hydroelectricity for Québec.
- Marketing outside Québec to maximize profits from export sales as well as the other advantages offered by interconnections with neighboring systems.
- More flexible development of the generating and transmission system to take into account all profitable markets.
- A quality of service which responds to the expectations of all customer categories.
- Technological development oriented toward the utility's short, medium and long-term need associated with the technological leadership that will contribute to the gradual diversification of the company's activities.

Management Orientation

A flexible structure that allows decisions to be made close to where their results are felt and emphasizes strategic planning, coordination and control, accompanied by rigorous management practices stressing the measurement of results and the evaluation of performance and which, by contributing to the implementation of development orientations, seeks to achieve an adequate return on equity and an overall improvement in the financial situation of the company.

1
Transitional Period

From the early 1980s, the imbalance between electricity supply and demand, exacerbated by the 1981-82 recession, the worst in more than 50 years, brought a serious deterioration of the company's financial situation, made worse by the decline in the value of the Canadian dollar and the drop in the price of oil. Hydro-Québec had to act rapidly on its financial commitments, expenses and revenues, to adapt to this new environment.

This represented a major change of direction, implemented in the short-term strategy the company developed for the *Development Plan 1983-1985, Horizon 1992*, and clarified in subsequent plans.

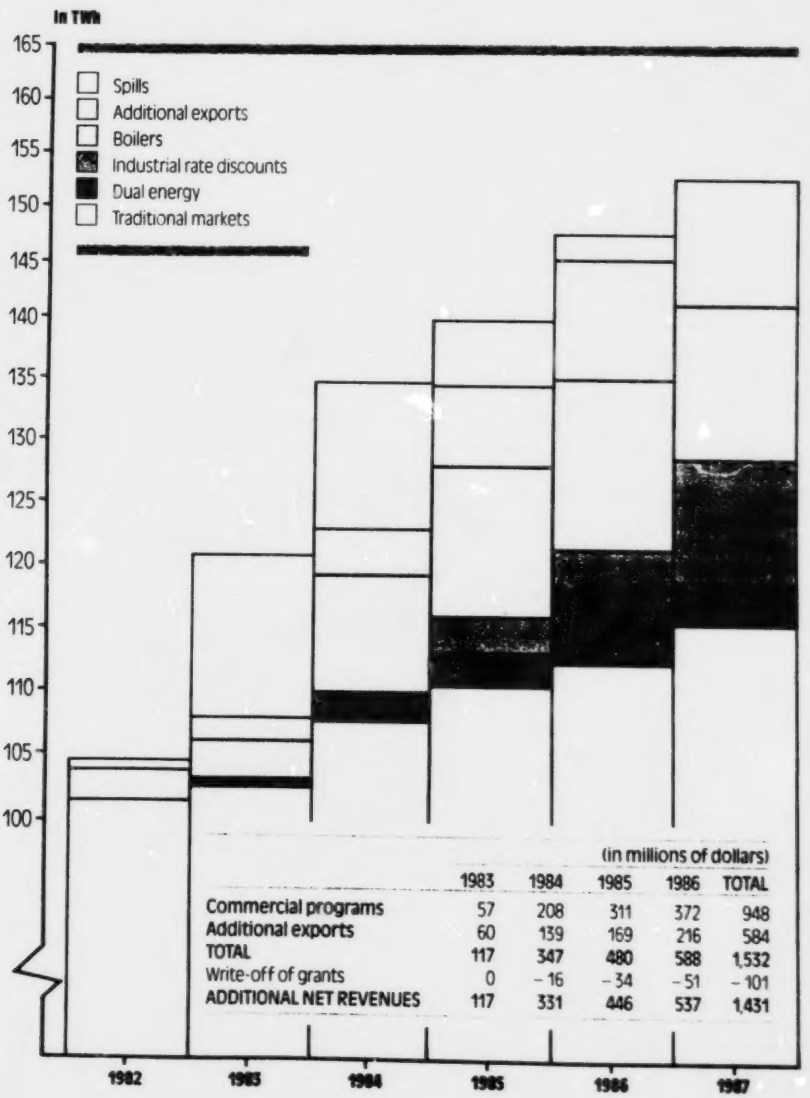
To return to equilibrium, Hydro-Québec formulated in its *Development Plan 1985-87, Horizon 1994*, a long-term orientation that included a basic orientation and development and management orientations.

The results of this short-term strategy have been felt gradually during the last four years and will continue to influence the financial situation of the company for several years to come.

1.1
Actions Affecting Revenues

Sales efforts have taken the form of the industrial boiler, dual-energy heating, rate discount and industrial expansion incentive programs on the Québec market and the increase in interconnection capacity and intensification of their use for export. The additional sales resulting from this marketing program have meant additional revenues of $1.532 billion over the last four years.

Figure 1.1
Impact of marketing efforts



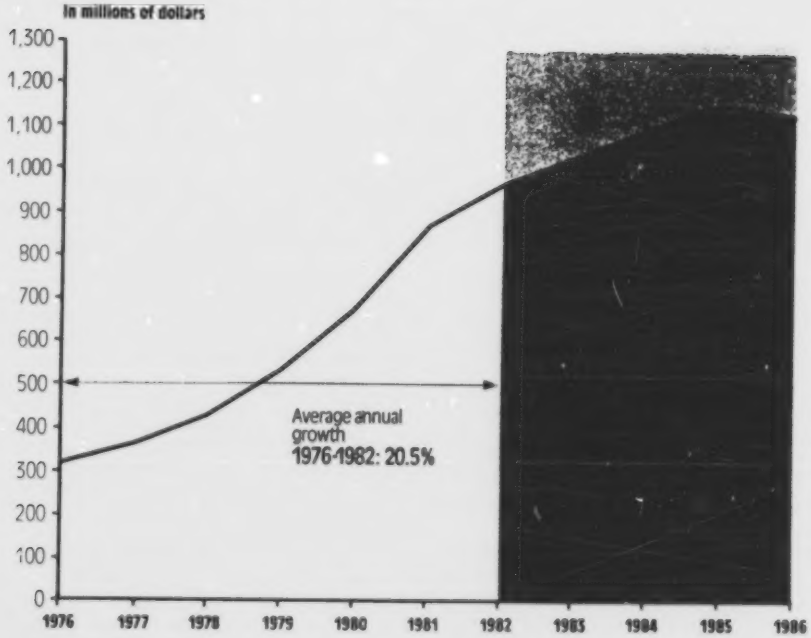
(in millions of dollars)

	1983	1984	1985	1986	TOTAL
Commercial programs	57	208	311	372	948
Additional exports	60	139	169	216	584
TOTAL	117	347	480	588	1,532
Write-off of grants	0	– 16	– 34	– 51	– 101
ADDITIONAL NET REVENUES	117	331	446	537	1,431

1.2
Actions Affecting Expenses

Expenses were essentially reduced by stabilizing the payroll over the last four years, achieved by reducing the number of employees and amount of overtime and by diminishing the lead in overall remuneration of staff compared to employees of other large Québec companies.

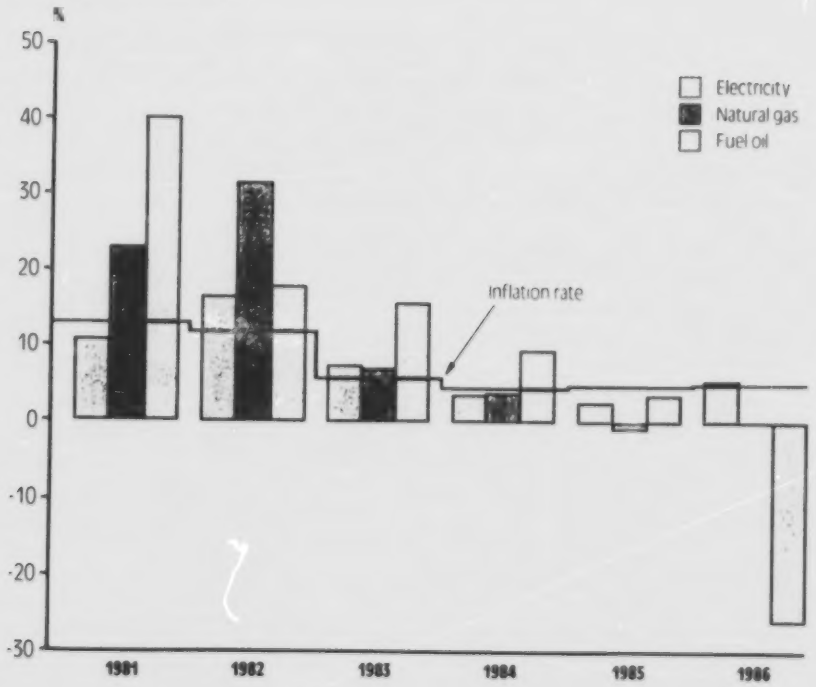
Figure 1.2
Changes in Operating Expenses



1.3
Limitation of Rate Increases

Rate increases over the last four years fell from 16.3% in 1982 to 7.3% the next year, then to 3.4%, 2.5% and 5.4% in 1986, a trend that reflects the desire of the company to maintain its competitive position compared to other forms of energy while supporting sales efforts for disposing of surpluses.

Figure 1.3
Average Rate Increases



Chapter 2

External Environment

Principal economic and energy-related assumptions used in drawing up the Development Plan.

Table 2.1

Main Parameters of the External Environment

Parameters	Historical	Estimate	Forecast		
	1985	1986	1987	1988	1989
Growth of Québec real domestic product (%)	4.3	3.3	2.8	2.8	2.8
Consumer Price Index – Montréal (%)	4.4	4.9	4.4	4.7	5.2
Interest rates on bonds for 10 years and more (%)					
– Canadian government	11.1	9.3	9.5	10.2	10.0
– American government	10.8	7.8	7.9	8.5	9.2
Interest rates on Hydro-Québec bonds for 10 years and more (%)					
– Canadian market	11.6	9.9	10.2	11.0	10.8
– American market	11.7	9.1	9.2	9.8	10.7
Canadian – US dollar exchange rate (at year end)	0.715	0.724	0.715	0.715	0.722
International price of crude oil in US dollars per barrel	27.5	15.1	16.0	17.0	18.0

2 The External Environment

Analysis and forecasting of the external environment provide the main economic and energy assumptions required for load forecasting and defining the financial framework. They also seek to determine, using alternative scenarios, the margin for maneuver available to Hydro-Québec in the short term in establishing and applying its management and development policies and to find the most effective means for increasing management flexibility and reducing long-term vulnerability.

2.1 The Economic Environment

For the next three years, we have assumed moderate economic growth as the probable scenario. The United States will be subject to deficit reduction measures and the impact of tax reform. Although favorable to consumers, this reform will probably slow down investment. Canada will be pulled in the American wake. Canadian exports should increase only slightly while investments will be limited because of the depressed state of the energy sector. Like its trading partners, Québec can expect some sluggishness, and Hydro-Québec is forecasting average economic growth of 2.8% until 1989.

The probable, if weak, recovery in the price of certain raw materials will result in a slight increase in the general inflation rate. Interest rates should therefore increase slightly. The Canadian dollar will remain under pressure in coming years because the elements of uncertainty, such as a problematic trade balance and unfavorable terms of trade, are likely to improve only slowly.

Québec after 1989

An estimate of the potential that can be achieved by the Québec economy suggests a growth rate of 2.7% per year from 1989 until 2006. However, given the uncertainties, a likely range for long-term growth between 1.9% and 3.2% has been assumed. The most important sources of growth will be mainly in export-oriented sectors. For Hydro-Québec, growth in demand for electricity will be increasingly dependent on a few industries.

Pulp and paper mills are overall Hydro-Québec's largest industrial customers. Sales of electricity to this industry will depend on the growth of production, estimated at 1.3% per year in the long term, and the penetration of new technologies that are heavy consumers of electricity. The smelting and refining of metals such as aluminum are Hydro-Québec's second largest industrial consuming sector. Profiting from the world-wide restructuring of this industry, Québec will see its aluminum production capacity increase by nearly 75% in the next twenty years and a magnesium plant will be commissioned in 1989.

2.2 The Energy Environment

The new international energy environment and the deregulation of fuel prices in Canada engender great uncertainty. The reference scenario adopted by Hydro-Québec anticipates an international crude oil price at least 30% lower than forecasts of only 2 or 3 years ago, rising from US $16 in 1987 to US $20 in 1991 because of a recovery in demand. Thereafter, the risks of new control of prices by OPEC increase, so a real rise of 2% per year for the next decade is projected.

2.3 Institutional Framework

Major changes in Hydro-Québec's commercial environment may result from current trade liberalization negotiations between the United States and Canada. These talks should not compromise the fundamental orientations of the present development plan, in that they comply generally with the standards of American electrical utilities. Thus, in both Québec and external markets, the main Hydro-Québec objectives are to recover production costs and obtain an adequate return on equity, according to the risk inherent in the development of each of these markets. Moreover, hydroelectric generation respects very rigorous environmental standards, implying major investments by Hydro-Québec. Although the company is not subject to corporate taxation, it pays other taxes from which American utilities are exempt. The legitimacy of Hydro-Québec's marketing programs also appears undeniable. These programs respond to the criteria of profitability or can be justified, as in the case of electrotechnologies, by the necessity for developing long-term markets.

A re-evaluation of the role of the National Energy Board, the agency which issues licenses allowing Hydro-Québec to export electricity to the United States, might also affect the operating environment.

Chapter 3

Québec Markets

Quality service, selective market development and equitable rates policy.

Table 3.1

Rate of Growth of Sales of Firm Electricity in the Reference Scenario

1986-2006	2.7%
1986-1991	3.8%
1991-1996	3.2%
1996-2001	2.1%
2001-2006	1.6%

Figure 3.1

Sales of Firm Electricity in Québec According to Alternative Scenarios

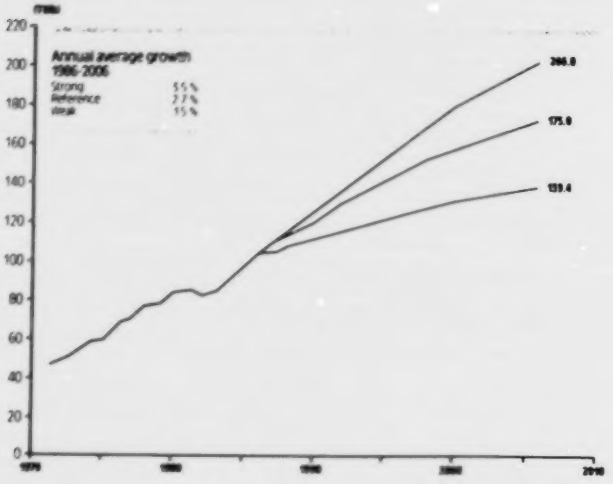


Table 3.2

Effects of Selective Market Development on Peak Needs (in MW)

	1986	1996	2006
Reference load	23,570	32,320	39,190
Effects of dual-energy and rate policy	– 20	– 890	– 1,120
Effects of expansion of interruptible power capacity		– 1,500	– 1,500

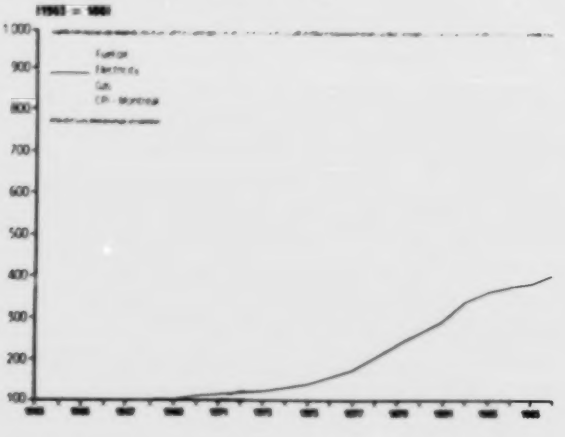
Table 3.3

Rate Increases

– Assumptions used in the preparation of the plan	
1987	4.9%
1988	5.2%
1989	5.2%
– Rate recommendation for 1987 in the *Mémoire sur la tarification proposée pour 1987*	

Figure 3.2

Inflation and the Price of Energy



3
Québec Markets

Hydro-Québec wishes to continue to develop the markets it considers profitable and retain those it already supplies, increasing, if possible, its profitability by reducing the costs of supply. It should gradually eliminate some temporary markets that have ceased to be profitable as soon as the risks of spills have disappeared. This is the case of the industrial boiler program, which will decrease as contracts now in effect expire.

Annual average load growth will be 2.7% from 1986 to 2006, for an average increase of 3.6 TWh per year. There will also be a continual reduction in the rate of growth, however, from the combined effect of demographic slow-down and saturation of the heating market.

Table 3.4

Sales of Firm Electricity by Hydro-Québec in Québec
(Reference Scenario)

In TWh	Historical		Forecast				
	1985	1986	1987	1988	1989	1991	1996
– Domestic-farm	38.4	40.5	41.2	42.1	42.8	46.1	51.6
– General	20.8	22.2	23.4	24.3	25.4	26.5	30.6
– Industrial	34.4	36.5	40.9	42.5	44.5	49.3	61.8
– Other	4.1	4.2	4.4	4.2	3.9	2.7	1.9
Total	97.6	103.5	109.9	113.0	116.6	124.7	145.8

On Québec markets, Hydro-Québec seeks essentially to:

- increase the quality of service
- undertake selective market development, mainly by promoting off-peak uses of electricity
- apply equitable and stable rates

3.1 Quality of Service

The quality of the service provided customers is vitally important. Maintaining and improving this quality are ongoing goals of the company that have a high priority. To achieve them requires various programs well adapted to needs and situations. It also necessarily implies daily activities by some 15,000 employees who, in operations and business practices, have the specific role of offering customers quality service. The company will also seek to diversify its services to reflect the needs of various segments of its clientele and stimulate a real customer service approach among all its staff.

3.2 Selective Market Development

3.2.1 Residential Market

Because the residential market is approaching saturation, Hydro-Québec will stress maintaining the existing market, without neglecting the development efforts begun in past years. This means especially efforts to manage demand in a way to promote off-peak use, such as dual-energy programs.

The existing dual-energy stock is now about 148,000 dwellings. It is a major asset for Hydro-Québec's long-term strategy. Sales of dual-energy heating occur in off-peak periods only, thus avoiding the necessity for further peak-load equipment. The potential of residential dual-energy for eliminating load requirement in peak periods is estimated at 700 MW.

To keep the dual-energy stock in the long term and to urge customers to use their dual-energy system in automatic mode, Hydro-Québec proposes to introduce adequate after-sales service and very attractive rates so long as customers heat with electricity in off-peak periods and use oil for heating in peak periods.

3.2.2 Commercial, Institutional and Industrial Markets

In 1985 and 1986, nearly 6,500 customers took advantage of the dual-energy program for institutional and commercial markets. Hydro-Québec estimates that there is still an important substitution market available. However, because of the low price of heating oil, the current situation is not very favorable. The new program, to begin in 1987, seeks customers whose current heating system is inefficient. The objective is 500 MW by 1988.

3.2.3 Industrial Market

The industrial market offers Hydro-Québec the greatest potential for expansion and it is where a good portion of its efforts will be directed. In addition to the dual-energy program already mentioned, Hydro-Québec will offer three marketing strategies that are specifically intended for this market: the **Interruptible Power Program**, industrial expansion based on **Risk and Profit Sharing**, and **Electrotechnology Implementation Assistance Program**.

As the result of studies conducted in 1986, Hydro-Québec proposes to expand its inventory of **interruptible power** and improve the rate terms associated with it. Starting in the winter of 1986-87, actions have allowed adding a first additional block of 200 MW, bringing interruptible power capacity from 500 MW to 700 MW.

In the 1996 horizon, the goal is 2,000 MW, or 1,500 MW more than at the start of 1986. This represents an annual credit to participating customers of nearly $100 million. The competitiveness of these companies should be enhanced by this initiative, while it allows Hydro-Québec to avoid investments in peak-load equipment of the order of $1 billion in the 1996 horizon.

The industrial expansion strategy based on **risk and profit sharing**, already announced last year, will receive new attention during the coming years. The goal of this marketing strategy is to increase the share of electricity in the industrial market and to contribute to expanding Québec's industrial base. The target clientele consists of industries where energy expenses are a major portion of production costs and electricity can offer a substantial comparative advantage.

The **electrotechnologies program** is also in its early stages, since it was only launched in 1985. This program is intended to replace fuel-oil based systems for industrial processes where electricity can be more productive. In this way, the program can also improve the competitiveness of participating customers or stimulate the creation of new industries. In 1986, implementation of new processes under the program resulted in additional sales of 200 GWh; this figure should reach 700 GWh in 1987. The availability of hydroelectricity attracted major industrial investors, including Aluminerie de Bécancour inc. and the Norwegian multinational Norsk Hydro.

3.3
Rate-setting Strategy

The rate-setting strategy is the result of a balance between the best price signal to give consumers to orient their choices and the desire of the company to maintain rate increases as low as possible. Hydro-Québec also seeks to shelter customers from rate shocks. To achieve that implies that the company has a reasonable margin for maneuver that results from a normal return on the capital invested.

The contribution of various markets to the overall rate of return varies a great deal, depending on the rate category. Although rate increases in the past (except 1983 and 1986) were differentiated by rate category, substantial discrepancies still exist. This results in cross-subsidization among markets.

This cross-subsidization distorts the market mechanism and gives the consumer an unrealistic price signal. Furthermore, cross-subsidization makes it difficult to obtain a normal rate of return and is likely to cause abrupt rate increases in the longer term.

Table 3.5

Rate of Return by Rate Category in 1986

Rate Categories	Average Selling Price ¢/kWh	Rate of Return %
D	4.2	1.9
G	5.5	29.2
M	4.4	27.9
L	2.8	10.5
Average	4.0	11.4

It is therefore necessary to correct these discrepancies so that each market can be profitable by itself. However, Hydro-Québec does not wish to correct the situation too abruptly, and so the rate of catching up in certain rate categories will reflect the economic situation and the prices of competing energies.

The rate strategy has two stages. Over the next three years, Hydro-Québec is seeking a rate of return of the order of 13% on overall capital invested in its Québec markets. Later, it will seek to achieve this rate of return on each of its Québec markets, in order to reduce the cross-subsidization.

In all cases, even if costs of supply vary from one region to another, Hydro-Québec intends to maintain uniform rates on its interconnected power system, in order to promote regional development.

Table 3.6

Québec Markets: Strategies

Objective 1	Maintain personalized relationships with the various segments of the clientele in order to increase customer satisfaction and sustain efforts to maintain and develop electricity markets.
Strategies	– Dialogue with consumer associations – Customer service approach by personnel – Communications systems to be used in planned power interruptions – Standardization of business practices – Marketing efforts in collaboration with outside parties – Review of billing methods – Improved handling of complaints – Communications systems for customers with hearing and visual handicaps
Objective 2	Achieve selective development of markets in order to be able to offer advantageous options to customers, in view of their individual needs, and in order to reduce the costs of supplying electricity.
Strategies	– Promote off-peak consumption • Raise interruptible power capacity to 2,000 MW • Maintain residential dual-energy • Introduce new dual-energy program (commercial, institutional and industrial) • Testing of remote control (load management) – Other industrial marketing efforts • Risk and profit sharing formulas • Electrotechnology Implementation Assistance Program
Objective 3	Limit rate increases to close to those of anticipated inflation, while gradually reducing the cross-subsidization among customer categories; gradually adapt the rate structures to promote the development of profitable markets.
Strategies	– Recommendation for 1987 amendments to the Rates Bylaw. – Rate options to encourage off-peak consumption

Chapter 4

External Markets

Strategies geared to selling firm power and energy.

Figure 4.1

Export Electricity Sales

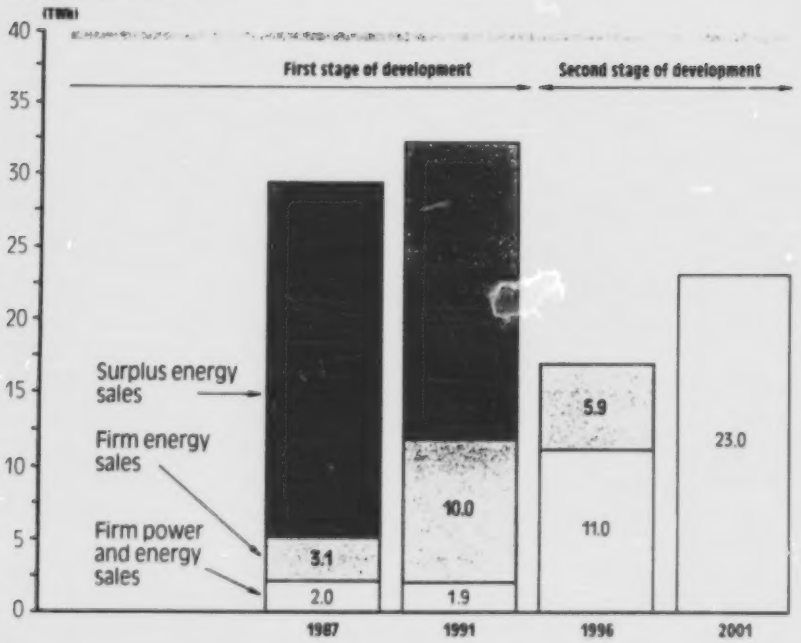


Table 4.1

Interconnection Capacity with Neighboring Systems in 1990 (MW)

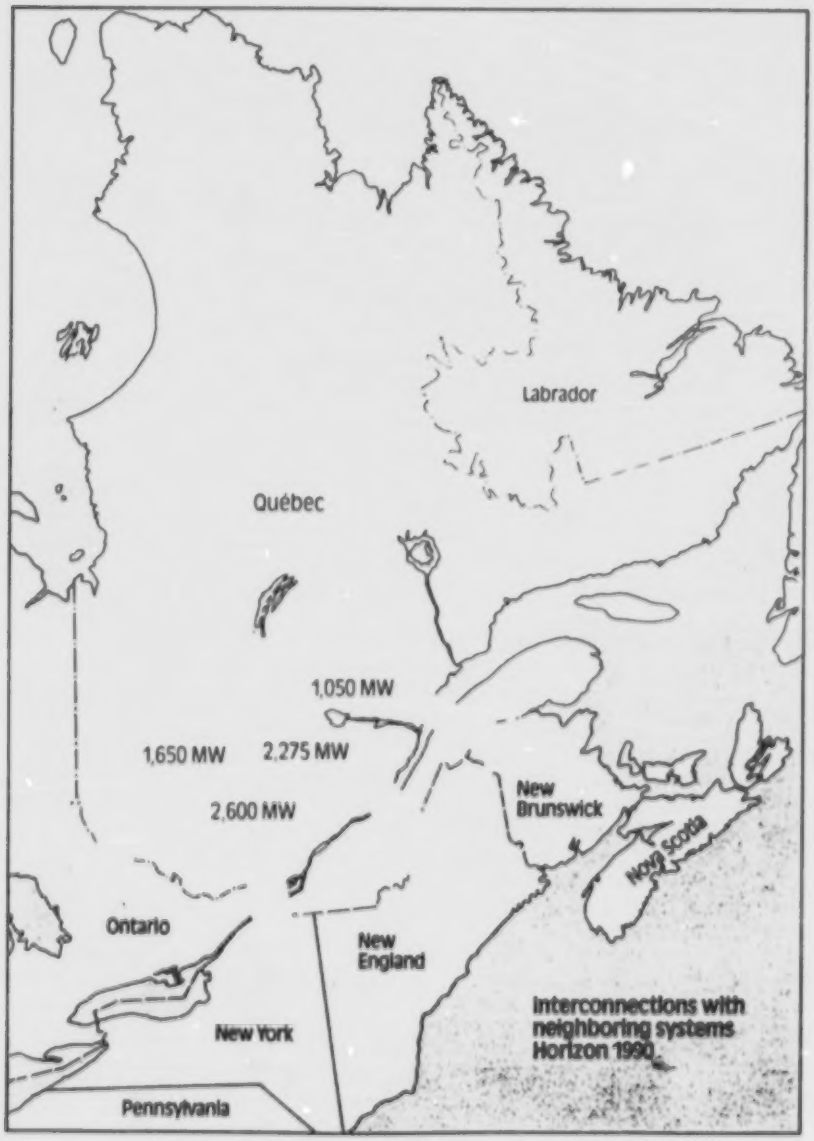
Canada	
– New Brunswick	1,050
– Ontario	750*
	1,800
United States	
– New England	2,275
– New York	2,600*
	4,875
Total Canada and United States	6,675

*Interconnection capacity with Ontario is 1,650 MW. It can only be used to its maximum by reducing exports to New York State by 900 MW.

4
External Markets

The sale of the company's surpluses was the first step in developing external markets. In 1985, to develop them beyond disposing of surpluses, the company adopted an orientation of achieving a lasting breakthrough in exports. This orientation was in response to the 1983 enlargement of Hydro-Québec's mission, which gave new latitude for exploring avenues for developing external markets, as long as they did not interfere with satisfying Québec's own needs and where they offered profitability that corresponds to that expected by shareholders in the private sector for projects of comparable risk, taking into account the additional costs of supply that are in fact incurred and the risks associated with such development.

Figure 4.2
Neighboring Systems



4.1
The Market in Neighboring Systems

At this time, demand in neighboring systems, which are the systems of New England and New York, as well as the Canadian systems in New Brunswick and Ontario, is mainly satisfied by the output of oil and coal-fired, nuclear and hydroelectric generating stations.

The increase in demand for electricity in neighboring systems will be satisfied for some time yet by the addition of nuclear generating stations now being built and the increased use of existing oil-fired stations. These additions will temporarily accentuate present power surpluses. Nevertheless, the surpluses will gradually be re-absorbed by projected increases in load.

Power and energy shortfalls will appear progressively by the end of the century, first in power in 1996 and then in energy. In the 2001 horizon, power deficits are estimated at 5,900 MW.

These shortfalls assume that present load management programs and development of major co-generating capacity on the part of independent producers are extremely successful. They also assume that current programs to extend the lifespan of existing oil and coal-fired power stations are carried out and the new nuclear generating stations now being built are in fact commissioned. Likewise, they assume average load growth.

If the load growth assumptions used by the neighboring systems in their development plans should be revised upward by one-half a percentage point, the 5,900 MW market might reach nearly 13,900 MW in the 2001 horizon.

4.2
Proposed Products

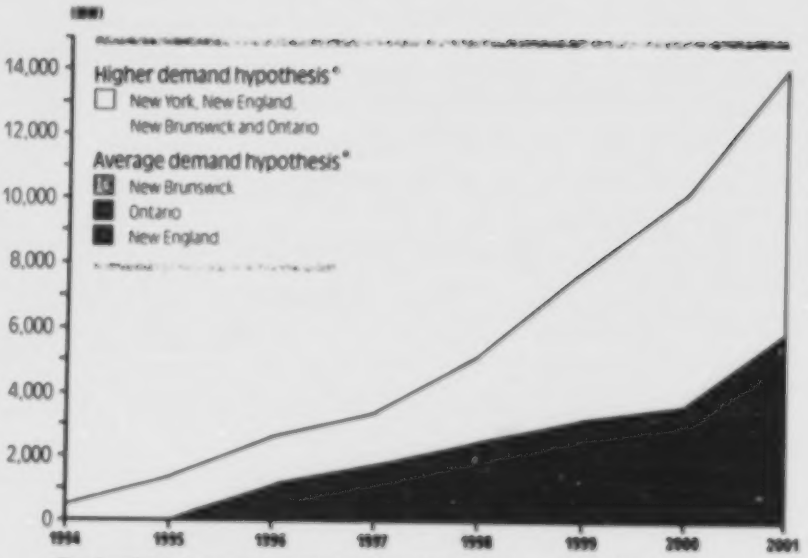
4.2.1
Firm Power and Energy

To satisfy power shortfalls that will appear in the 2001 horizon, besides the construction of new base-load generating stations and importing electricity from neighboring American and Canadian systems, the neighboring systems could also develop new programs in addition to the existing ones, intended to intensify load management and extend the life of existing generating stations.

Given the general uncertainty about fuel prices and the future of the electricity market, American power systems tend to adopt solutions requiring less investment. Nevertheless, some of these power and energy shortages are likely to be satisfied by new base-load generating stations.

Importing electricity from Hydro-Québec is an attractive solution for the neighboring systems in that it offers the same security of energy supply as base-load equipment while not requiring such large investments on their part. In 1986, Hydro-Québec continued negotiations with neighboring systems for the sale of firm power and energy. To that end, a letter of intent was signed in February 1987 which, by the end of the year, should lead to the conclusion of a contract with Central Maine Power Company for the sale of blocks of firm power and energy, starting with 400 MW in 1992 and reaching 600 MW in 1995, 900 MW in the year 2000, and later declining progressively before the contract expires in 2020.

Figure 4.3
Power Shortfalls



*The shortfalls in New York State appear before 2001 only in the case of higher demand.

Following the first stage of development, which consists of disposing of surpluses available until 1995, the company foresees a second stage of development, with sales of firm power and energy to the neighboring systems between now and the year 2000 of up to 3,500 MW for an average length of 15 years. Under favorable conditions, this quantity might rise to 4,500 MW. This option will allow a lasting and profitable breakthrough to exports using the existing interconnections and reflecting the addition of interconnections of moderate size.

After 2001, the power deficits on neighboring systems may rise rapidly. The third stage of export development targets this potential market. However, it will require the installation of long transmission lines, which presents special technical and environmental problems.

In all cases, even though the three stages of development imply deliveries at different times, each one will now require substantial efforts from Hydro-Québec, varying in terms of what is at stake at each stage. The strategies corresponding to each stage are summarized in Table 4.2.

4.2.2
Oil Replacement

At this time, a major proportion of the needs of neighboring systems is filled by oil-fired generating facilities. However, the profitability of Hydro-Québec sales to replace energy generated from these stations is a function of the price of oil and appears uncertain in the current context of oil price fluctuations.

Nevertheless, from 1987 to 1995, Hydro-Québec expects to still have energy surpluses to sell on the surplus energy markets. Sales on the oil-fired generation substitution market should therefore continue until 1995.

Table 4.2

External Markets: Strategies

FIRST STAGE OF DEVELOPMENT		
Objective 1	Maximize revenues associated with the sales of existing surpluses.	
	Strategies	– Increase product value by guaranteeing deliveries
		– Adjust price to reflect market changes
SECOND STAGE OF DEVELOPMENT		
Objective 2	Consolidate the breakthrough on export markets by commitments for sales of firm power and energy to neighboring systems of 3,500 MW to 4,500 MW by the year 2000.	
	Strategies	– Pursue negotiations for the sale of firm power and energy
		– Develop medium-size interconnections
		– Optimize the use of existing interconnections
THIRD STAGE OF DEVELOPMENT		
Objective 3	Pursue steps seeking sales of firm power and energy to neighboring systems beyond the quantities planned in the second stage of development.	
	Strategies	– Adapted price formulas
		– Innovative financing methods
		– Feasibility studies on the delivery of larger quantities of electricity
		– Pursue discussions with neighboring systems for sales beyond the 3,500 MW mark
		– Pursue promotional efforts with various agencies, both American and Canadian

Chapter 5

Installations

Strategies for improvement of existing installations and flexible development of future installations in line with the utility's sales objectives.

Table 5.1

Commissioning Dates
(Target Construction Program)

Peak-load Equipment	
• Manic 5 AC	1989
• LG 2 A	1992-1993
• Manic 3, 2, 1 AC	1995-1998
• Other peak-load projects	1995-2003
Base-load Equipment	
• La Grande complex Phase II	1995-1997
• Sainte Marguerite	1998
• Grande Baleine	1999-2000
• Ashuapmushuan	2001-2002
• NBR	2003-

Table 5.2

Decision Timetable for Phase II of the La Grande complex

Project	Completion of studies & permits	Decision	Commissioning
LG 1	1988	1989	1995-1996
Brisay	1988	1991	1996
LA 1	1988	1991	1997

Table 5.3

Supply and Demand for Electricity
(in TWh)

	Historical	Estimate				Forecast	
	1985	**1986**	**1987**	**1988**	**1989**	**1991**	**1996**
DEMAND							
Sales in Québec							
– Firm	97.6	103.5	109.9	112.9	116.3	124.0	145.2
– Surplus	12.1	13.7	13.3	13.3	1.8	–	–
Export Sales							
– Firm	6.9	7.0	5.1	5.1	5.0	11.9	16.9
– Surplus	17.3	19.9	24.0	22.8	25.0	20.4	–
Total Sales	133.9	144.1	152.3	154.1	148.1	156.3	162.1
Deliveries as per agreement	3.5	3.2	3.3	3.3	4.0	4.0	4.0
Total Deliveries	137.4	147.3	155.6	157.4	152.1	160.3	166.1
SUPPLY							
Generation							
– Hydroelectric	111.8	123.8	129.5	131.9	125.8	135.2	143.5
– Thermal	3.7	4.3	5.4	5.0	5.0	4.9	5.0
Purchases	34.5	32.8	34.9	34.9	35.6	35.3	34.2
Less: Electrical losses	12.6	13.6	14.2	14.4	14.3	15.1	16.6
Total Deliveries	137.4	147.3	155.6	157.4	152.1	160.3	166.1

5
Installations

The development of installations is intended to satisfy shortfalls that are expected to appear starting in 1995 if all sales and existing installation improvement efforts are in fact implemented. To do this, Hydro-Québec will also take advantage of substantial undeveloped potential.

5.1
Production

By 1996, renovation and the increased automation of operations of hydroelectric generating stations, combined with increased output from Gentilly 2 and the commissioning of LG 2 A, will increase the average energy supply by about 3.5 TWh/year compared to 1986.

The company has potential energy generating capacity of the order of 200 TWh/year. Some of this potential, about 90 TWh per year, would be more economical than any other electricity generating option. This includes nuclear generating stations as well as oil or coal-fired. These projects are listed in increasing order of cost in Table 5.4.

Table 5.4
Undeveloped Hydroelectric Potential

	TWh		MW*	
	Per project	Cumulative	Per project	Cumulative
• Phase II of the La Grande complex	13.8	13.8	2,464	2,464
• Sainte Marguerite	4.2	18.0	822	3,286
• Grande Baleine – Phase I (1,978 MW) – Phase II (913 MW)	15.1	33.1	2,891	6,177
• Ashuapmushuan	3.6	36.7	533	6,710
• NBR – Phase I (2,280 MW) – Phase II (2,200 MW) – Phase III (1,850 MW) – Phase IV (2,370 MW)	46.5	83.2	8,700	15,410
• La Romaine	8.9	92.1	1,710	17,120

*Assuming a utilization factor of 60%

5.2
The Transmission, Sub-transmission and Distribution Systems

Electricity is sent to residential and commercial customers and to small industries through the transmission, sub-transmission and distribution systems. Major industries and the neighboring systems are supplied directly from the transmission system.

Because of its structure, Hydro-Québec's transmission system is particularly vulnerable to certain disturbances that could lead to chain reactions in protection systems and result in a general power failure.

In order to avoid the consequences for neighboring systems of a general power failure at Hydro-Québec, exports using direct-current ties must now be limited to 2,200 MW. Beyond such power levels, any export must be made radially, from an isolated source of supply.

The improvement of the transmission system, at a cost of $600 million from 1988 to 1991, eliminates these constraints and allows all exports to be made from Hydro-Québec's main system. This solution would also make it possible to develop export markets by earlier construction of generating and transmission facilities required in the longer term by Hydro-Québec, rather than dedicating installations to export markets. Furthermore, it would allow flexibility in supplying neighboring systems, independent of the selected points of supply or starting date of export contracts.

A major program with total funding of $1 billion, $400 million of which is for the sub-transmission system, has been in effect since 1984, to improve continuity of service throughout the territory. It is designed to make improvements at all levels where strengthening is necessary. At the end of 1986, the company had completed work covering half the total budget; 60% of the budget for the sub-transmission system has already been spent.

5.3
The Target Construction Program

The target construction program will allow demand for electricity in Québec to be satisfied, taking into account the effect of the selective development of markets and the export of 3,500 MW in the 2000 horizon. This construction program is based on a ranking of projects in order of increasing cost. It is made possible by the transmission system improvement strategy which would allow using the main Hydro-Québec transmission system for the exports projected in the target scenario. Without such a strategy, it would be necessary to dedicate certain generating stations to exports. This could result in modifications in the order of commissioning dates, depending on when the contracts begin, and therefore a more expensive construction program.

Hydro-Québec expects to commission additional capacity at Manic 5 AC in 1989 and LG 2 A in 1992-1993, while Phase II of the La Grande complex would be commissioned between 1995 and 1997, with the LG 1, Brisay and LA 1 generating stations.

Table 5.5

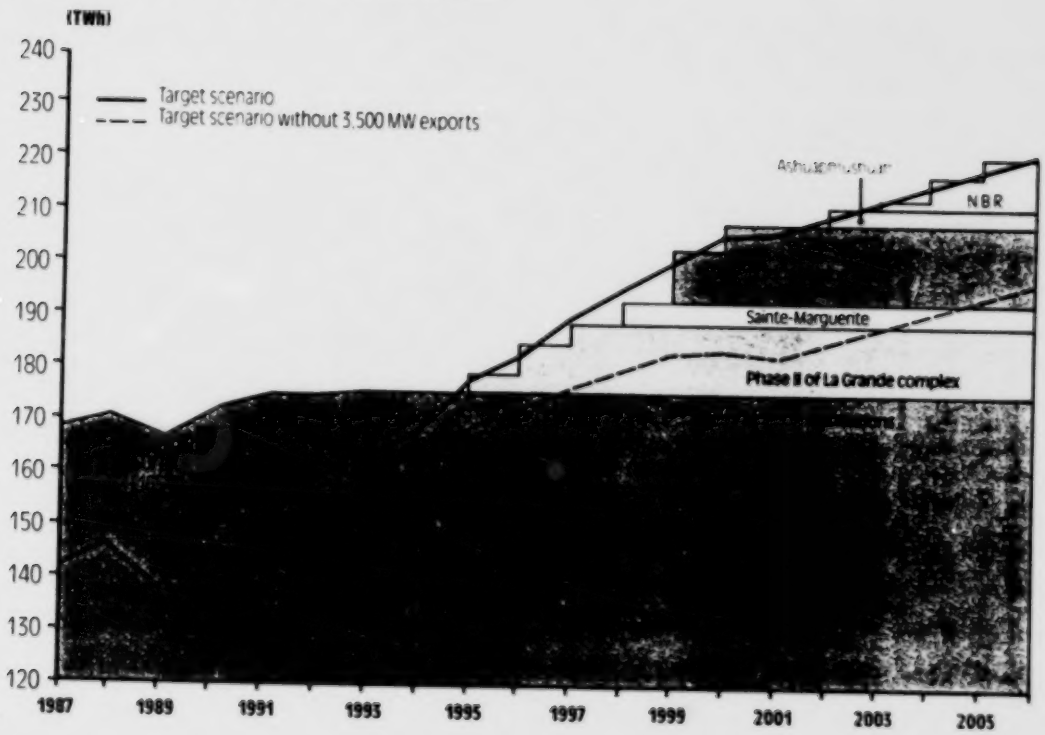
Target Construction Program

	Maximum Peak Power	Commissioning Dates
	MW	
Peak-load Equipment		
Manic 5 AC	980	1989
LG 2 A (first three units)	950	1992
LG 2 A (last three units)	950	1993
Manic 3, 2, 1 AC	835	1995-1998
Other peak-load projects	1,300	1995-2003
Base-load Equipment		
La Grande complex, Phase II	2,464	1995-1997
Sainte Marguerite	822	1998
Grande Baleine	2,891	1999-2000
Ashuapmushuan	533	2001-2002
NBR	8,700	2003-

Figure 5.1 illustrates the re-scheduling of the base-load equipment required by export sales of firm power and energy of 3,500 MW. In the early 1990s, these sales come from available surpluses. Afterwards, it would become necessary to build the various hydroelectric projects in the program earlier, starting with Phase II of the La Grande complex.

Figure 5.1

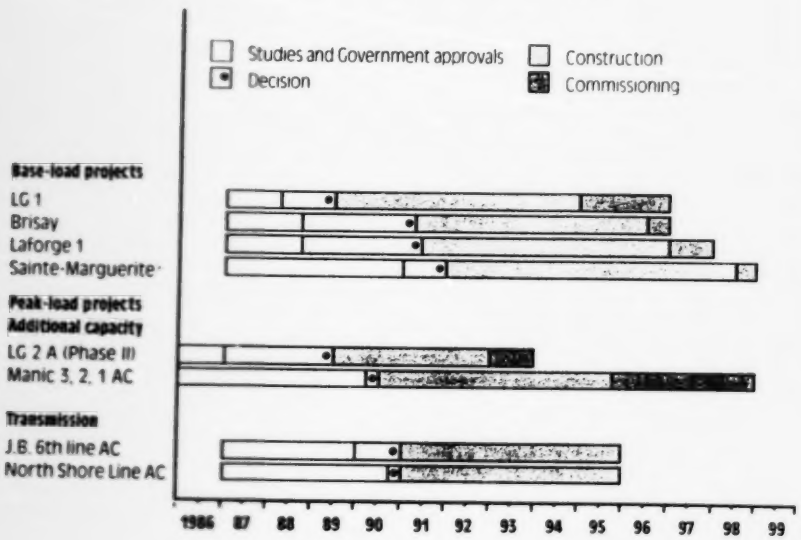
Rescheduling of Projects for 3,500 MW of Exports



*Because of energy losses on the power system, surplus sales are estimated at 156 TWh.

Figure 5.2

Decision-making Timetable of the Target Construction Program



*Obtaining of government approvals for Sainte-Marguerite may be postponed for one year

If there should be strong growth in Québec demand, no improvement in existing installations and no 3,500 MW of exports, the date for commissioning Phase II of the La Grande complex could be moved ahead one year, to 1994-95 rather than 1995-97.

5.4 Investments

Overall investments for the 1987-1996 period total $36.7 billion with the target program of 3,500 MW of exports. Table 5.6 shows the investments corresponding to the alternative scenarios of Québec load growth, without exporting 3,500 MW.

Table 5.6

Investments (1987-1996)
(Billions of current dollars)

Scenarios	1987	1988	1989	Period 1987-1996
Target	**1.9**	**2.7**	**3.0**	**36.7**
Strong (3.5%)	1.9	2.6	3.6	43.4
Reference (2.7%)	1.9	2.5	2.8	30.4
Weak (1.5%)	1.9	2.4	2.7	21.0

Table 5.7

Installations: Strategies

Objective 1	Reduce the number and duration of service interruptions by enhancing the reliability of the system.	
	Strategies	– Restore the level of quality of service by completing by 1988 the $985 million program ($487 million in 1987-88)
		– Improve quality of service per customer category
		– Improve the architecture and design of the underground distribution system
		– Define and introduce new design criteria for the transmission system ($600 million in 1988-1991)
Objective 2	Renovate, refurbish and modernize installations.	
	Strategies	– Renovate generating stations ($3.2 billion in 1987-1996)
		– Alternative solutions for supplying isolated power systems
		– Manage environmental risks linked to the operation of installations
Objective 3	Increase production capacity of existing plant.	
	Strategies	– Automate system operating centres ($1.4 million)
		– Improve operating training of staff
		– New methods to ensure energy reserves
Objective 4	Pursue automation of systems and maintenance procedures.	
	Strategies	– Modernize the distribution operations centres
		– Pilot project for the remote control of strategic switching points on the system
		– Remote handling and robots for system maintenance ($25 million from 1987 to 1989)
Objective 5	Plan the generating facilities and transmission system of Hydro-Québec both to satisfy contract commitments and provide the flexibility needed to adjust rapidly to market changes in the markets	
	Strategies	– Commission Manic 5 AC in 1989
		– Commission the first three units of LG 2 A in 1992
		– Prepare the decisions required in 1989 for future generating and transmission equipment
		– Identify the environmental parameters for the general development of a number of projects in a region

Chapter 6

Technology and Diversification

Strategies for attaining the utility's principal objectives and diversifying activities through intensified marketing of expertise in technological development.

Technology Orientations

Help reduce the costs of supplying electricity.

Help solve technological problems related to electricity exports.

Help improve the quality of service, occupational health and safety and environmental quality.

Sustain sales of electricity by the development and distribution of electrotechnologies.

Promote the commercial exploitation of technology and expertise.

Stimulate innovation and staff participation.

6
Technology and Diversification

Most areas of the company's activities offer major challenges for which technology is an essential component: replacement and modernization of installations, increasing electricity exports, load management, electrotechnologies and remote controls.

Technology implies a complex organizational structure where operational groups and the centralized Research, Development and Demonstration (RDD) services must work together. The company will implement mechanisms promoting technological discussion and a more efficient allocation of resources.

While satisfying the company's needs, new technological products must also contribute to Québec's economic development and to maintaining or improving the quality of life of its citizens.

Table 6.1

Technology and Diversification: Strategies

Objective 1	Orient technological development activities more toward the achievement of the company's major objectives.	
	Strategies	– Enhance participation of groups in the orientation and follow-up of RDD activities by establishing in 1987 a technology cooperation forum whose main purpose is to identify the technological development priorities on a corporate and industry level.
		– Accentuate efforts in technological exploration and development.
		– Continue the development and demonstration of new processes using electricity, taking advantage of the new electrochemicals and electrotechnologies laboratory (L.T.E.E.) completed at the end of 1986.
Objective 2	Increase the commercial value of technological development activities and make use of them as a means of diversification.	
	Strategies	– Intensify internal and external marketing in order to promote the use of the laboratories, sale of expertise and participation in government and private research programs
		– Improve understanding of the commercial potential of technological development activities in selecting projects and technical solutions
		– In fields associated with or related to energy, execution, especially by Nouveler, of industrial activities that make use of developed technologies in association with partners.
Objective 3	Improve the organizational framework of technological development activities.	
	Strategies	– Differentiate management according to the nature of RDD activities
		– Management by objective
		– Encourage innovation by a mechanism for evaluating suggestions and offering rewards.

Chapter 7

Human Resources

Measures for implementing new management practices at Hydro-Québec, with the emphasis on concerted action with employee groups and revision of existing policies.

Table 7.1

Positions and Manpower

	Historical						Forecast		
	1981	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
Permanent Positions*									
– Authorized in January	20,162	20,584	20,631	19,600	19,400	19,350	19,825	19,600	19,600
Permanent Staff*									
– Staff in January	18,635	19,482	19,959	18,975	18,560	18,208	18,470	19,003	19,193
– Hires during year	1,263	802	146	217	595	487***	833	475	375
– Departures during year									
• retirement	179	170	871	501	803	114	175	160	150
• other	237	155	259	131	144	111	125	125	125
– Staff on December 31	19,482	19,959	18,975	18,560	18,208	18,470	19,003	19,193	19,293
Temporary Staff**									
– Operations	2,286	2,520	1,610	1,886	2,788	2,326	2,032	1,832	1,832
– Construction	906	521	262	186	195	242	361	580	540
– Decrees	419	488	114	114	180	181	155	250	230
Total	3,611	3,529	1,986	2,186	3,163	2,749	2,548	2,662	2,602
SEBJ-Management Staff Total person-years	2,163	1,366	982	485	200	121	169	208	215

*Excludes subsidiaries
**Average based on 26 pay periods
***Includes return of 11 employees from subsidiaries

Table 7.2

Staff Distribution Ratios

Ratios at December 31	**1982**	**1983**	**1984**	**1985**	**1986**
Average staff per manager	6.74	7.53	8.51	9.48	9.51
Percentage of head office staff out of total staff	22.68	19.72	19.52	17.73	17.37

7
Human Resources

Human resources management at Hydro-Québec has been marked by significant changes during the major periods of growth. The initial phase of sustained growth ended in the early 1980s. At the beginning of 1983, permanent staffing had reached a peak of nearly 20 000 people.

The following imbalance between supply and demand for electricity resulted in measures that had a major impact on human resources reduction in outside recruiting, a major early retirement program, staff recycling and redeployment programs, reduction of the lead in general remuneration for Hydro-Québec staff over those in large companies operating in Quebec, a lightening of the hierarchical structure and decentralization of activities and resources. These measures reflect Hydro-Québec's efforts to rationalize spending and ensure better customer service.

Hydro-Québec is now preparing for another stage of development to begin in the 1990s. This period, when the company will intensify its sales efforts in Québec and on export markets, will also be characterized by limited growth in staff and will therefore require greater stress on expanded training, specialization and mobility by present staff. The company also expects more involvement from employee groups formed on the basis of common interests.

Table 7.3
Human Resources: Strategies

Objective 1	Continue collaboration with various groups of employees to harmonize their objectives with those of Hydro-Québec.	
	Strategies	– Prepare a succession program for first-level managers
		– Increase the representation of women inside the company
		– Introduce an assistance program for employees with substance abuse problems
		– Collaborate in the formation and operation of an association of Hydro-Québec retirees.
Objective 2	Revise policies and practices which require adaptation to a new human resources management context.	
	Strategies	– Review the universality of benefit plans
		– Adjust compensation policy to the new economic context and the company's orientations
		– Evaluate the feasibility of new work schedules
		– Measure the impact of contracting-out on employment
		– Adapt equipment, work methods and the labor code to regulations on the use of safety locking devices.

Chapter 8

Financial Management

Attainment of long-standing minimum financial criteria, more rigorous control of financing costs and financial risks; over the medium term, re-establishment of the financial maneuvering room the utility had at the start of the 1980s.

Table 8.1

Financial Framework of the Target Scenario

In millions of dollars	Historical 1985	Estimate 1986	Forecast 1987	1988	1989
Revenues					
– Sales of firm electricity in Québec	3,541	3,857	4,187	4,504	4,865
– Sales of surplus electricity in Québec	209	167	119	151	24
– Export sales of electricity	673	649	641	677	736
– Other operating revenues	69	61	62	66	69
Total Operating Revenues	4,492	4,734	5,009	5,398	5,694
Expenses					
– Operating expenses including:	1,163	1,129	1,196	1,314	1,453
• Amortization of write-offs	90	93	15	15	0
– Other operating expenses	787	854	910	966	1,027
Total Operating Expenses	1,950	1,983	2,106	2,280	2,480
Income Before Interest and Exchange Losses	2,542	2,751	2,903	3,118	3,214
– Interest	2,075	2,259	2,282	2,208	2,232
– Exchange losses	258	189	277	223	206
Interest and Exchange Losses	2,333	2,448	2,559	2,431	2,438
Net Income	209	303	344	687	776
Dividends Likely to Be Declared	0	0	0	0	292

Table 8.2

Principal Ratios

	Historical 1985	Estimate 1986	Forecast 1987	1988	1989
Return on equity (%)	3.2	4.4	4.8	8.9	9.4
Interest coverage	1.12	1.15	1.18	1.22	1.19
Capitalization ratio (%)	24.1	24.0	24.0	24.8	25.0
Self-financing ratio (%)	35.7	41.0	35.6	41.9	33.0

8
Financial Management

8.1
Necessity for Restoring a Margin for Maneuver

8.1.1
Loss of Margin for Maneuver Since the Early 1980s

Hydro-Québec was able to preserve a solid financial position until 1984 while remaining competitive on the markets because it had, at the outset, a sound financial situation with sufficient room for maneuver. Until 1984, despite surpluses of electricity and falling exchange rates, Hydro-Québec generally respected its minimum financial criteria. In 1985 and 1986, however, when the company no longer had sufficient margin for maneuver to completely absorb the additional shocks on the energy and exchange markets, some financial ratios fell below the minimum, such that no dividend could be declared. Thus, the capitalization ratio was somewhat below the minimum level of 25%, while the return on equity was falling well below the cost of the debt, amounting to 4.4% in 1986.

Without the margin for maneuver available in the early 1980s, the deterioration of Hydro-Québec ratios would have been much greater, with consequences for its credit rating and that of Québec. To avoid these consequences, it could have been forced to increase rates substantially in a particularly difficult period.

Table 8.3
Financial Performance by Hydro-Québec

	1980	1981	1982	1983	1984	1985	1986*
Interest coverage	1.18	1.01	1.01	1.04	1.10	1.12	1.15
Capitalization ratio (%)	25.5	25.1	26.1	26.6	25.3	24.1	24.0
Return on equity (%)	18.6	12.0	15.0	11.7	4.7	3.2	4.4
Net income (millions of $)	746	559	800	707	301	209	303
Net income/electricity revenues (%)	30.9	20.2	24.6	19.7	7.3	4.7	6.5

*Estimate

8.1.2
Increase in the Company's Overall Risk

Recent changes in Hydro-Québec's financial situation testify to its vulnerability to an increasingly unpredictable economic and energy environment. Furthermore, the implementation of some of the strategies of the development plan will modify the overall risk configuration for the company, even though the expected benefits are substantial.

Hydro-Québec has made commitments in risk and profit sharing contracts with customers that are heavy users of electricity. This strategy is intended to give maximum stimulation to economic development in Québec, while recovering on average the costs of supplying electricity during the life of the contract, without making other consumers bear the burden of the discounts traditionally granted to attract industries. However, if the economic situation were unfavorable for several years, these contracts would temporarily be less profitable for Hydro-Québec.

Other strategies intended to reduce the average costs of the company will expose it to higher costs in some years. Tight management of water reserves, which reduces fixed costs, could in years of exceptionally low run-off force recourse to other measures, such as the operation of oil-fired generating stations or, as a last resort, purchases of support from neighboring systems. The same applies to borrowing strategies at variable interest rates rather than fixed rates. Variable-rate debt is usually less expensive than fixed rate, but in some years the opposite can be the case.

The development of external markets will be based on the earlier construction of facilities, which introduces different elements of uncertainty: long-term price formulas not directly related to Hydro-Québec costs, at least for the second stage of external market development, large individual contracts, and the possibility of not finding outlets in Québec for energy when the export contracts run out. However, this strategy will enable the utility to gradually replace surplus energy sales with firm power and energy sales, and therefore reduce the risks associated with fuel price fluctuations.

Some strategies will reduce the risks. This is the case of external market development strategies, which reduce exchange risks by providing a better balance in American dollar inflows and outflows. The same applies to the development strategies for all markets, both Québec and external, which favor the replacement of surplus energy sales with firm power and energy sales.

What, concretely, do these risks mean? They imply that in some years, Hydro-Québec may face a combination of earnings shortfalls and additional expenses. The company's planning must take these possibilities into account and sufficient margin for maneuver beyond its minimum financial criteria must be created.

8.2
Two-stage Financial Strategy

Recent experience has thus showed the necessity, in the short-term, to restore or maintain the traditional minimum financial criteria; then, in the medium term, find sufficient margin for maneuver by regaining the traditional criterion of a return on equity equal to or greater than the cost of debt. Without this margin, any major disruption in the company's environment would mean either sudden rate hikes in electricity's captive markets, an unacceptable choice, or further worsening of the financial criteria, which could seriously harm the government's guarantee. Hydro-Québec's debt is 47% of the debt contracted and guaranteed by the Québec government, which represents for its part 45% of Québec's GDP. Annual refinancing of $1 billion needed over the coming years requires regular access to the financial markets.

A margin for maneuver is thus necessary to ensure rate stability and to allow borrowing on attractive terms. This is fundamental if Hydro-Québec is to again invest in large generating facilities in the early 1990s. It is also necessary to establish a policy of paying dividends that reflect the profitability of the company and its self-financing needs.

Improvement of the financial situation and restoration of a margin for maneuver will result from the elimination of the supply-demand imbalance. This will allow selling kilowatthours, now sold at a discount on surplus energy markets, for prices that better reflect the costs of supply. They will also result from the cost reduction strategies and the application of the rate policy.

8.3
Sensitivity of Financial Results

Financial forecasts are subject to unpredictable events in the economic and energy environment, since the underlying assumptions are subject to major variations. In the short and medium term, the changes in oil prices and the value of the Canadian dollar are potential sources of the greatest variations in the company's financial forecasts, although interest rate developments could also constitute a disruptive element.

The current financial forecasts are made in an economic context of growth. As recent years have clearly shown, however, a large variation in economic parameters may have a major impact on the financial results included in this framework.

Table 8.4

Sensitivity of Net Income in 1987

Parameters	1987 Forecasts	Variations	Variations in Net Income (millions of $)
Sales of firm electricity in Québec	109.9 TWh	+ 1%	42
Sales of surplus electricity in Québec	13.3 TWh	+ 1%	1
Export sales	29.1 TWh	+ 1%	6
Rates	4.9%*	+ 1%	23
World price of crude oil	16 $US barrel	as of May 1st + 1 $US/barrel	19
Operating expenses	1,196 million $	+ 1%	-12
Interest rates	10.2%	+ 1%	-24
Canadian-US dollar exchange rate**	0.715 $US	+ 0.01 $US	26
Exchange rate for Canadian dollar compared to a basket of currencies other than the US dollar		+ 1%	10

*Assumption used in Table 8.1

**Impact of exchange on interest charges in US dollars and on the exchange loss in US dollars incurred on maturity dates during the year

Table 8.5

Financial Management: Strategies

Objective 1	Over the next three years, restore a capitalization ratio of at least 25% while maintaining an interest coverage of at least 1.0 and self-financing of at least 30%. Thereafter, regain a rate of return on equity equal to or greater than the cost of debt.	
	Strategies	– Cost reduction efforts – Profitable export markets given the risks – Rates more consistent with the cost price and a return on equity greater than the cost of the debt.
Objective 2	Reduce financing costs and exercise closer management of financial risks.	
	Strategies	– Share financing and certain risks with partners – Maximize financing in Canadian dollars – Terms of 10 years and more – Refinancing – Term contracts or options – Variable rate debt.

Chapter 9

Economic Spinoffs

Hydro-Québec, a driving force behind economic growth and development.

Table 9.1

Hydro-Québec's Economic Development Levers and Job Creation

Construction program	– Fabrication agreements – Improvement in quality of service – Export development
Development of Québec markets	– Marketing programs – Competitive pricing – Electrotechnologies – Differentiated products – Sharing of risks and profits
Technological Development	– Marketing of technology – Diversification – Hydro-Québec expertise
Contribution to Québec government revenues	– Taxes – Dividends

Table 9.2

Jobs Supported by Hydro-Québec

In person-years	Historical		Estimate	Forecast		
	1984	1985	1986	1987	1988	1989
Electricity generation and distribution activities	38,665	39,535	36,930	39,875	46,825	48,315
Jobs related to operations	20,325	20,710	19,880	20,160	20,990	21,225
– Direct	15,185	15,850	15,140	15,535	16,160	16,395
– Indirect	5,140	4,860	4,740	4,625	4,830	4,830
Jobs related to capital expenditures	18,330	18,825	17,050	19,715	25,835	27,090
– Direct	9,170	9,740	8,875	9,950	12,140	12,690
– Indirect	9,160	9,085	8,175	9,765	13,695	14,400
Electricity marketing activities*	23,590	21,230	21,230	17,920	13,195	10,735
Jobs related to marketing programs	16,175	8,840	9,855	8,145	3,210	1,000
– Dual energy	980	1,755	1,280	195	70	70
– Electrotechnologies	–	255	570	815	880	930
– Rate discounts	13,140	5,995	7,820	7,070	2,260	–
– Other programs	2,055	835	345	65	–	–
Jobs related to rate advantages granted to companies that are heavy consumers of electricity	7,415	12,390	11,210	9,775	9,985	9,735
Total	62,245	60,765	58,160	57,795	60,020	59,050

* Revised figures for 1984 and 1985

Table 9.3

Direct Contributions by Hydro-Québec to Government Revenues

In millions of current $	Historical		Estimate	Forecast		
	1984	1985	1986	1987	1988	1989
Taxes	224	246	272	294	312	331
Dividends	156	0	0	0	0	292
Total	380	246	272	294	312	623

9 Economic Spinoffs

Hydro-Québec intends to play a role that substantially exceeds its traditional contribution as builder of large hydroelectric projects. Many of the strategies of the development plan will promote improvement in the competitive ability of the Québec economy.

9.1 Impact of Electricity Generation and Distribution Activities

Major economic spinoffs will result from the execution of the construction program. More than $7.6 billion will be invested over the next three years. This program should allow Hydro-Québec to maintain a staff of nearly 22,000 permanent and temporary employees, as well as supporting on average more than 23,000 jobs among outside firms asked to execute some of the construction program and among suppliers of goods and services established in Québec. Moreover, the growth of the investment program will offset, in terms of job creation, the withdrawal of the surplus disposal marketing program. Altogether, some 60,000 person-years of work will be supported annually by Hydro-Québec activities during the period from 1987 to 1989.

Furthermore, Hydro-Québec expects to optimize the economic spinoffs of its activities as an electricity producer and distributor by seeking forms of intervention that have more structuring effects on the economy than the creation of temporary construction jobs. Thus, the fabrication agreements that Hydro-Québec has made for disconnecting switches, circuit breakers, fuses and lightning arresters have contributed to enhancing Québec participation in the company's electrical distribution activities.

9.2 Impact of Marketing Electricity

The marketing strategies planned by Hydro-Québec will ensure a permanent replacement for the surplus disposal programs. In addition to being able to count on what are some of the most advantageous rates in the world, companies that wish to establish plants in Québec will be able to profit from more diversified products, because of the improvements in the interruptible power program, and reduce their comparative risks by negotiating contracts based on risk and profit sharing. This has been the case with Norsk Hydro and QIT.

Another aspect that Hydro-Québec is promoting is electrotechnologies. The company has committed nearly $12 million to industrial applications of electricity that expand the penetration of electricity into certain industrial branches, especially pulp and paper. Six projects are now under study in association with industrial partners, and the opening of the electrical and electrochemical technologies laboratory in Shawinigan should promote a multiplication of such applications.

The establishment of industries that are heavy users of electricity represents a major economic challenge for Québec. In this area alone, nearly 10,000 person-years of work will be created annually in these sectors over the next three years, more than three quarters of them in permanent jobs.

9.3 Impact of Technology, Marketing and Diversification

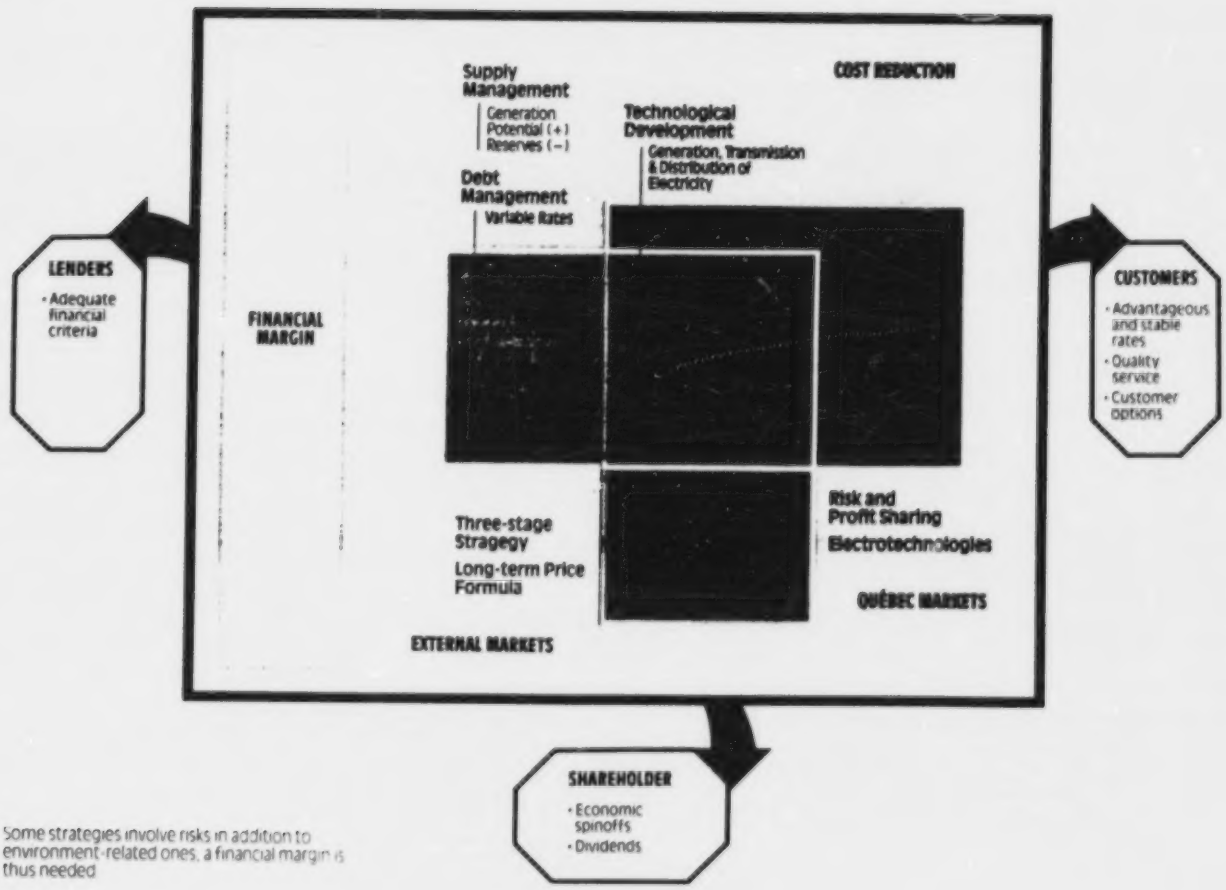
An important lever used by Hydro-Québec to promote greater Québec participation in marketing technologies developed by the company to satisfy its own needs is to grant Québec companies manufacturing licenses for these products. Sales of more than $7 million have resulted from the exploitation of Hydro-Québec patents in 1986, and strong growth in this area is expected in coming years.

Parallel to the development of the company's technology, Hydro-Québec is seeking to profit from its expertise and resources by promoting the emergence of projects or companies in fields associated with energy. This commitment has taken the form of the takeover of Nouveler Inc., which is now the vehicle preferred by Hydro-Québec for structuring its diversification efforts. Nouveler has contributed to the development of companies manufacturing heating equipment, recently combined in Venmar Inc. to allow public financing through stock. The new company specializes in making integrated heat-ventilation-air conditioning systems, and has more than 450 employees. Éconoler Inc. is another major development project, making turnkey energy conservation installations. This company has carried out more than 650 projects in Québec since 1981 and is pursuing its expansion on international markets in the United States, Europe and Asia. Nouveler is also active in a number of other small companies employing a total of more than one hundred people.

9.4 Hydro-Québec's Contribution to Québec's Government Revenues

The present tax contribution of Hydro-Québec is essentially the general tax on capital to which Québec corporations are subject and a tax on revenues from its sales of electricity, in lieu of property taxes. Approximately $300 million will be paid to the government annually in 1987 and 1988. In the not too distant future, however, Hydro-Québec's contribution will take the form of dividends that will result directly from the rate of return and financial margin requirements restored by the company.

Conclusion



Some strategies involve risks in addition to environment-related ones, a financial margin is thus needed

Conclusion

This plan has presented the strategies of the company for the coming decade. The strategies respond to three main concerns:

- Québec market development
- External market development
- Cost reduction.

Some of Hydro-Québec's strategies correspond to several concerns at once. This versatility appears very clearly in the case of the rate policy, load management and technological development, which respond to all three of the company's concerns. Rate policies and load management are central in that they promote efficient use of energy, which reduces the costs of supply for internal demand but also for developing exports, whose profitability is improved. Likewise, technological development strategies make it possible to reduce the costs of generating, transmitting and distributing electricity. They facilitate the development of internal markets by devising new uses of electricity and of external markets by improving the technology of interconnections.

Other versatile strategies also play a major role in Hydro-Québec planning. Since the Québec and external markets are supplied from the same system, the reliability of supply strategy affects them both. Likewise, certain external market development strategies assist in reducing costs. The increase in revenues from sales of electricity on American markets will allow a better balance between the needs for American currency for debt service and revenues in this currency, reducing the impact of the decline of the Canadian dollar on debt management. Likewise, interconnections with neighboring systems promote mutual assistance, allowing sharing of power reserves and, if needed, support purchases of energy. These are both measures that can result in cost reductions.

Finally, there are the strategies related to a single concern but which generally contain various risks that require a financial margin. These are strategies allowing risk and profit sharing with customers that are heavy consumers of electricity and the promotion of electrotechnologies appropriate for the Québec market. There is also the three-stage export development strategy and the price formula strategy, solely related to external market development. Finally, for cost reduction, there is the close management of supply, making it possible to increase output by hydroelectric installations, and the management of human, material and financial resources, which seeks to minimize the resources required for a given level of production.

The overall approach is based on supply optimization and load management integrated with energy marketing activities that are harmonized with price, quality of service and resource management policies intended to satisfy the expectations of the company's various partners. This is an approach which, supported by dynamic technological development, enables Hydro-Québec to fulfill its role as a public utility and amplify its role as an instrument of economic development.

Hydro-Québec Development Plan 1987-1989

HORIZON 1996

HYDRO-QUÉBEC DEVELOPMENT PLAN 1987-1989

HORIZON 1996

FEBRUARY 1987

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NOTE

Unless otherwise indicated in the text, the data used in this publication is from Hydro-Québec.

SYMBOLS OF MEASUREMENT UNITS

kV - kilovolt (unit of current strength)

kWh - kilowatthours (unit of energy)

TWh - terawatt hour (one billion kilowatt hours)

GWh - gigawatt hour (one million kilowatt hours)

MW - megawatt (unit of power

1. INTRODUCTION

In this development plan, Hydro-Québec presents the results of the review conducted over the last few years to clarify the company's orientations, objectives and strategies and guide them as a group and individually. The plan also acquaints the shareholder and principal partners of Hydro-Québec with the scope of its development prospects. This should facilitate expressions of opinions and a general discussion of the activities, which will in turn promote collaboration to make the best use of the advantages that hydroelectricity offers Québec.

Seen from this perspective, while covering a ten-year horizon, the plan focuses on the actions to be taken in the next three years. In the immediate future, Hydro-Québec will pursue the short-term strategy laid out in previous plans. This allows consolidation of the effects of the steps taken to reorient the company in accordance with the changes that have affected its environment. At the same time, Hydro-Québec is pursuing its plan to ensure long-term development.

In the medium and long term, the plan describes the development of the company according to several scenarios that relate to various paths to be explored. It points out their interaction with the main components of Hydro-Québec's environment: economic growth, market potential, energy price changes, and interest, inflation and the Canadian dollar exchange rates. However, these scenarios are only projections of the future. They clarify the choices available to the company and define the conditions for their achievement but offer no certainty as to which path should be taken. Changes in the environment can modify the underlying assumptions and necessitate a review of strategies and proposed actions. The future of the Canadian dollar exchange rate and the price of oil are particularly uncertain and are a good illustration of the nature of the risks the company must bear.

The plan first provides a review of past actions and briefly sketches the external environment. It establishes the reference demand for electricity and discusses Québec markets, then presents the strategies for development of external markets. It then turns to the operation and development of installations and looks at Hydro-Québec's prospects for developing technology and diversifying its activities. Human resource management, financial management and the financial framework for 1987-1989 are then discussed. The report concludes with a discussion of the impact of the strategies on Hydro-Québec's partners and explains the economic spinoffs of the development plan.

2. HYDRO-QUÉBEC IN TRANSITION

To understand the results and measure the impact of the actions taken in the course of recent years, they must be seen in the context of how the company has evolved. The present decade marks the transition between the period of growth in Québec demand for electricity that doubled every ten years and the 1990s, which will mark a new era in the company's development.

During the first period of its history, which lasted until the early 1980s, Hydro-Québec based its activities on successively commissioning new plant. This was in order to respond to a demand that doubled every ten years. Given the quality of the sites developed and the economies of scale achieved, plus major rate increases, the company was very profitable and had a financial situation that could support the accelerated growth of its plant.

From the early 1980s, the profound imbalance between electricity supply and demand, exacerbated by the 1981-82 recession, the worst in more than 50 years, brought a serious deterioration of the company's financial situation, made worse by the decline in the value of the Canadian dollar and the drop in the price of oil. Hydro-Québec had to act rapidly and energetically on its financial commitments, expenses and revenues, to adapt to this new environment. At the same time, the effects of the adaptation on its clientele, employees, shareholder and the Québec economy had to be kept to a minimum.

This represented a major change of direction, implemented in the short-term strategy the company defined in the **Development Plan 1983-1985, Horizon 1992**, and clarified in subsequent plans. The results of this short-term strategy have been gradually felt over the last four years and will continue to affect the company's financial situation for several years to come.

Once the transitional period is over, a third phase in the company's development should begin, in the 1990s. To define and prepare this phase, Hydro-Québec formulated its **Development Plan 1985-87, Horizon 1994**, a long-term orientation that included a basic orientation and its development and management orientations.

The long-term orientation corresponds to the context anticipated for the end of the century, when electricity will have reached the stage of maturity as a product. This means a gradual reduction in the growth of sales of electricity in Québec (Figure 1). The long-term orientation also includes the elements likely to expand the applications of electricity in Québec markets and achieve a lasting breakthrough on external markets, even at the price of the increased risks and other elements that will result in a gradual diversification of the company into other fields associated with or related to energy.

The current transitional period represents a true challenge. The actions that result from the short-term strategy continue to correct the current imbalance at the same time that other actions are necessary to clarify and implement the long-term orientation, to create a solid foundation for the company's development.

Figure 1 - **Electricity Sales in Québec**
Annual average rate of growth (%)

SHORT-TERM STRATEGY

Actions on Financial Commitments

- Make the investments for commissionings until 1985 and postpone construction of additional generating capacity.

Actions on Revenues

- Increase sales of electricity by a dynamic marketing effort on domestic and external markets.

Actions on Expenses

-Cut operating expenses.

Arbitrage to Optimize the Financial Situation in the Long Term

- Limit rate increases to encourage market penetration.
  . by accepting a short-term reduction in net income
  . while assuring respect for essential financial criteria:
    - interest coverage of 1.00;
    - capitalization ratio
    - of 25%.

LONG-TERM ORIENTATION

Fundamental Orientation

Provide electricity to Québec at the best conditions, optimize the comparative advantage that hydroelectricity constitutes for Québec and diversify its activities into fields connected with or related to power and energy.

Development Orientations

- Domestic marketing that focuses on customer satisfaction, based on a pricing policy that maximizes the comparative advantage of hydroelectricity for Québec.

- Marketing outside Québec to maximize profits from export sales as well as the other advantages offered by interconnections with neighboring systems.
- More flexible development of the generating and transmission system to take into account all profitable markets.

- A quality of service which responds to the expectations of all customer categories.

- Technological development oriented toward the utility's short, medium and long-term need associated with the technological leadership that will contribute to the gradual diversification of the company's activities.

Management Orientation

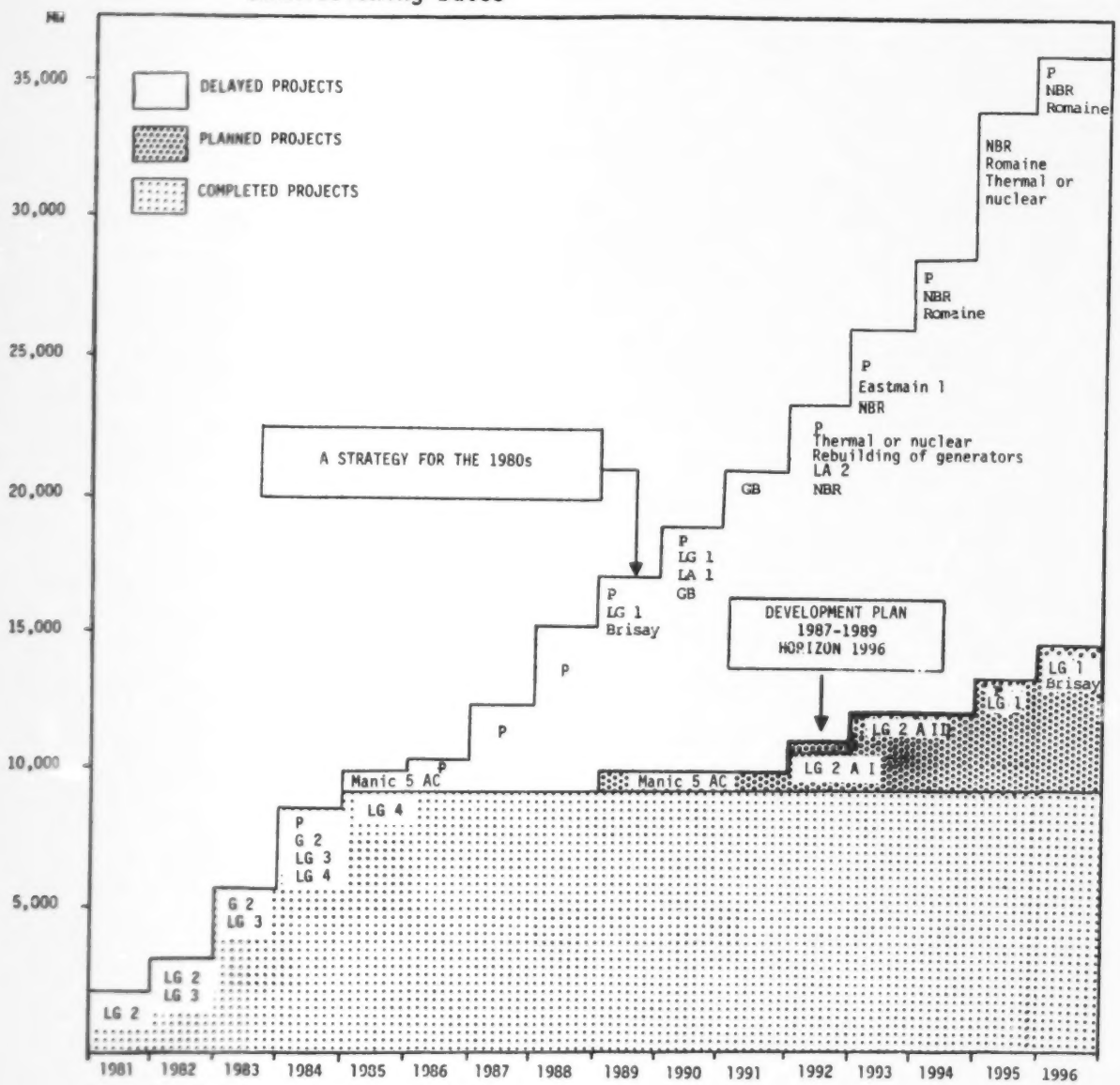
A flexible structure that allows decisions to be made close to where their results are felt and emphasizes strategic planning, coordination and control, accompanied by rigorous management practices stressing the measurement of results and the evaluation of performance and which, by contributing to the implementation of development orientations, seeks to achieve an adequate return on equity and an overall improvement in the financial situation of the company.

2.1 Review of the Short-term Strategy

Actions Affecting Financial Commitments

With reference to the construction program in **A Strategy for the 1980s**, published in December 1980 and discussed at legislative hearings in February 1981, all generating equipment planned for commissioning after 1985 has been postponed. Thus, of the 26,900 MW that Hydro-Québec expected to commission between 1985 and 1996, only 5,300 MW are now planned.

Figure 2 - **Comparison of 1981-1996 and 1987-1996 Construction Programs** Commissioning Dates

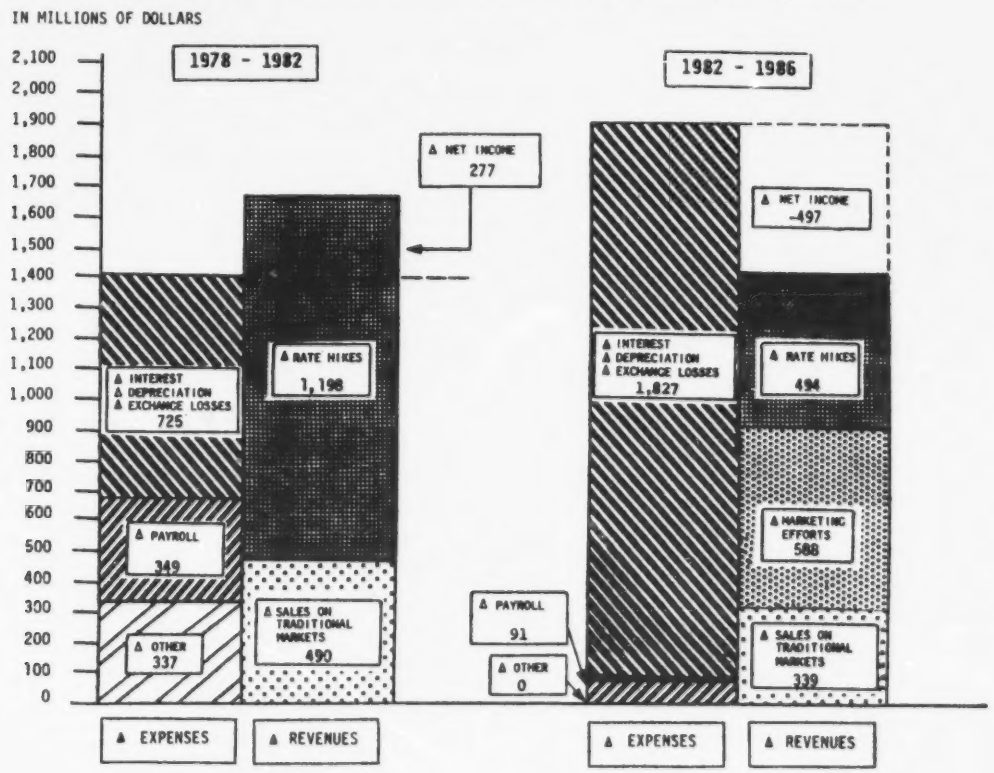


P: Peak-load equipment project

In spite of reductions of the company's financial commitments, investments for commissionings until 1985 meant substantially higher expenses over the last four years. It is true that Phase I of the La Grande complex was completed on time and within budget. However, the size of the projects commissioned over the last four years, the write-off or transfer to operating expenses of interest relative to preliminary studies of abandoned or suspended projects and the decline in the Canadian dollar exchange rate, combined with changes in accounting practices involving accounting for exchange losses since 1984, have substantially increased interest expenses, depreciation and exchange losses. This increase was $1.827 billion, more than two and one half that of the four previous years.

Weaker growth in revenues that Hydro-Québec obtained from its traditional domestic and external markets during this same three-year period, some $339 million, was offset by additional sales of $588 million from marketing efforts. However, despite a marked reduction in the increase of operating expenses, achieved mainly by stabilizing the payroll, maintaining the balance between increased revenues and expenses would have required rate increases that are incompatible with lower inflation and the prices of other forms of energy in this period. Thus, Hydro-Québec was led to reduce its rate increases and accept a marked drop in net income while respecting the requirements of sound financial management.

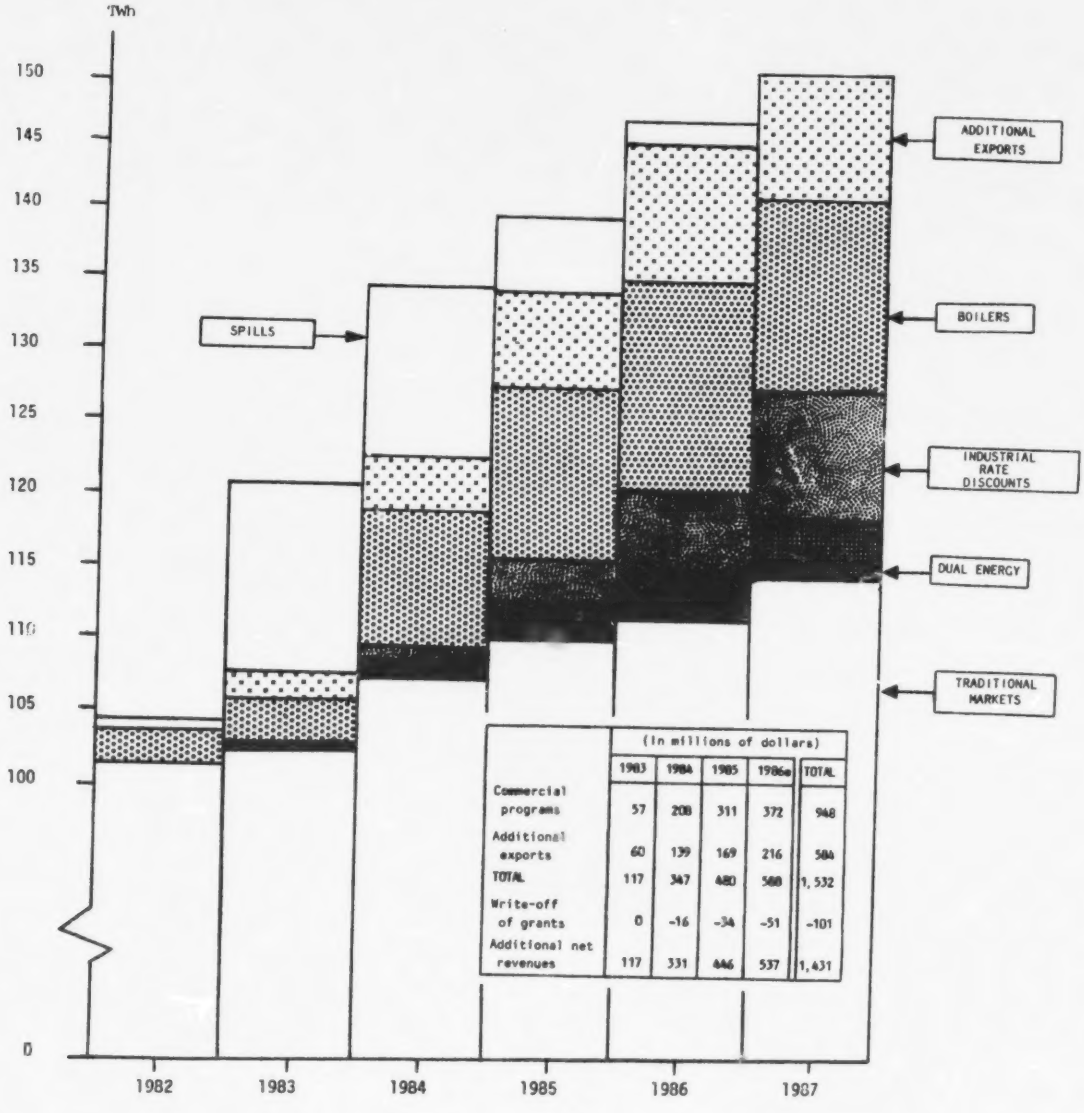
Figure 3 - **Overall Impact of the Short-term Strategy for Eliminating the Financial Imbalance**
Variation (△) in revenues and expenses per four-year period



Actions Affecting Revenues

The results obtained over the last four years and projected for 1987 reveal how essential sales efforts have been in Hydro-Québec's short-term strategy. These sales reflect the industrial boiler, dual-energy heating, rate discount and industrial expansion incentive programs on the Québec market and the increase in interconnection capacity and intensification of their use for export. The additional sales resulting from this marketing program have meant additional revenues of $1.532 billion in the last four years and have made a major contribution to enabling the company to return to a situation where it can reasonably expect to avoid large spills.

Figure 4 - **Impact of Marketing Efforts**



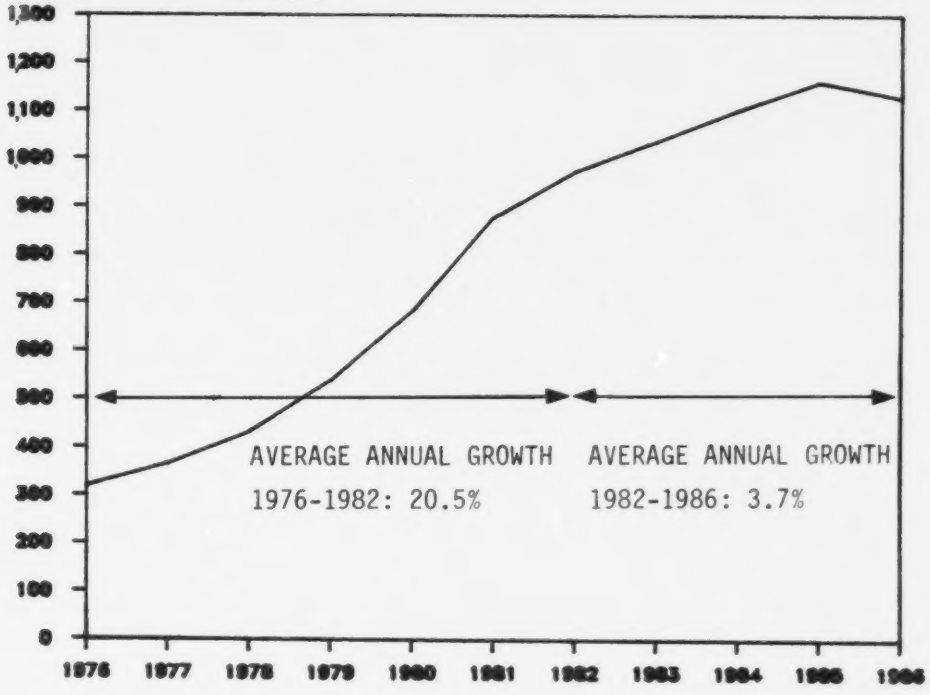
(In millions of dollars)	1983	1984	1985	1986e	TOTAL
Commercial programs	57	208	311	372	948
Additional exports	60	139	169	216	584
TOTAL	117	347	480	588	1,532
Write-off of grants	0	-16	-34	-51	-101
Additional net revenues	117	331	446	537	1,431

Actions affecting expenses

The results achieved by reducing and rationalizing expenses, more than half of which are operating expenses, cannot be evaluated solely on the basis of the major savings achieved over the past four years. Beyond this essential and immediate contribution to the better financial equilibrium for the company, the results obtained have placed Hydro-Québec in a situation where it can use the more adequate level of expenses to plan its budgets more in terms of the growth of its markets and its activities. To appreciate the significance of this achievement, it is enough to note the effect on operating expenses, whose annual average growth rate has dropped from a historical rate of more than 20% to about 4% over the last four years.

Figure 5 - **Changes in Operating Expenses***

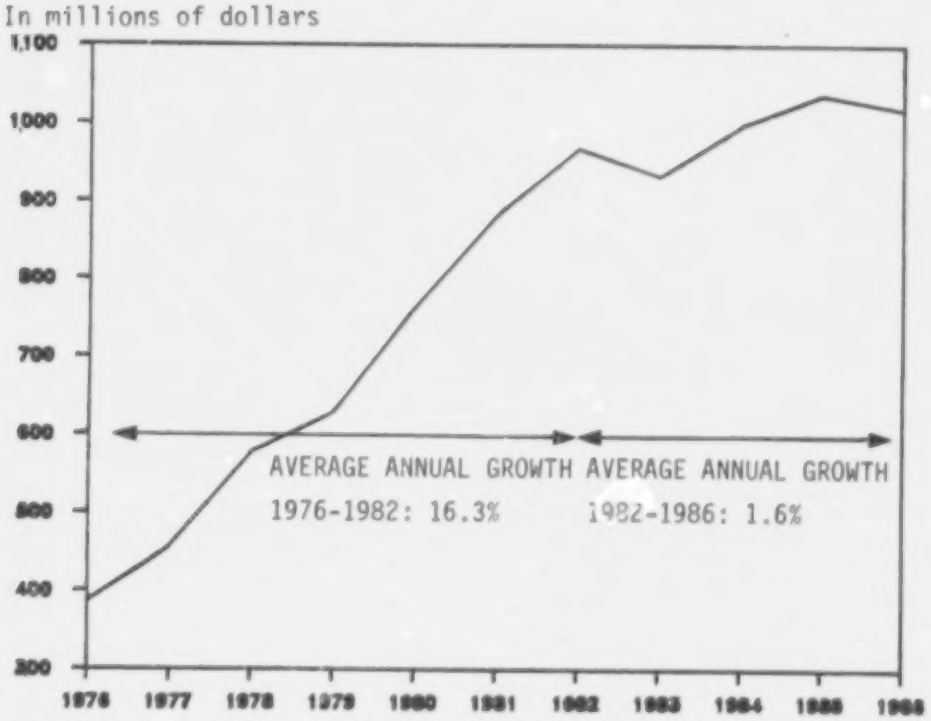
In millions of dollars



* Operating expenses, excluding purchases of electricity, depreciation of capital assets and taxes.

Essentially, the cost reduction has been achieved by stabilizing salaries during the last four years: a lower total number of hours because of reduction of staff or overtime, as well as a reduction in the rate of growth of average remuneration. Hydro-Québec has reduced the lead in overall remuneration for its employees compared to those in other large companies working in Québec, as a result of the collective agreements signed with the various unions representing employees. The stabilization of salaries has made a substantial contribution to reducing not only the rate of growth of operating expenses but also, although to a lesser degree, to the costs of capital investment projects.

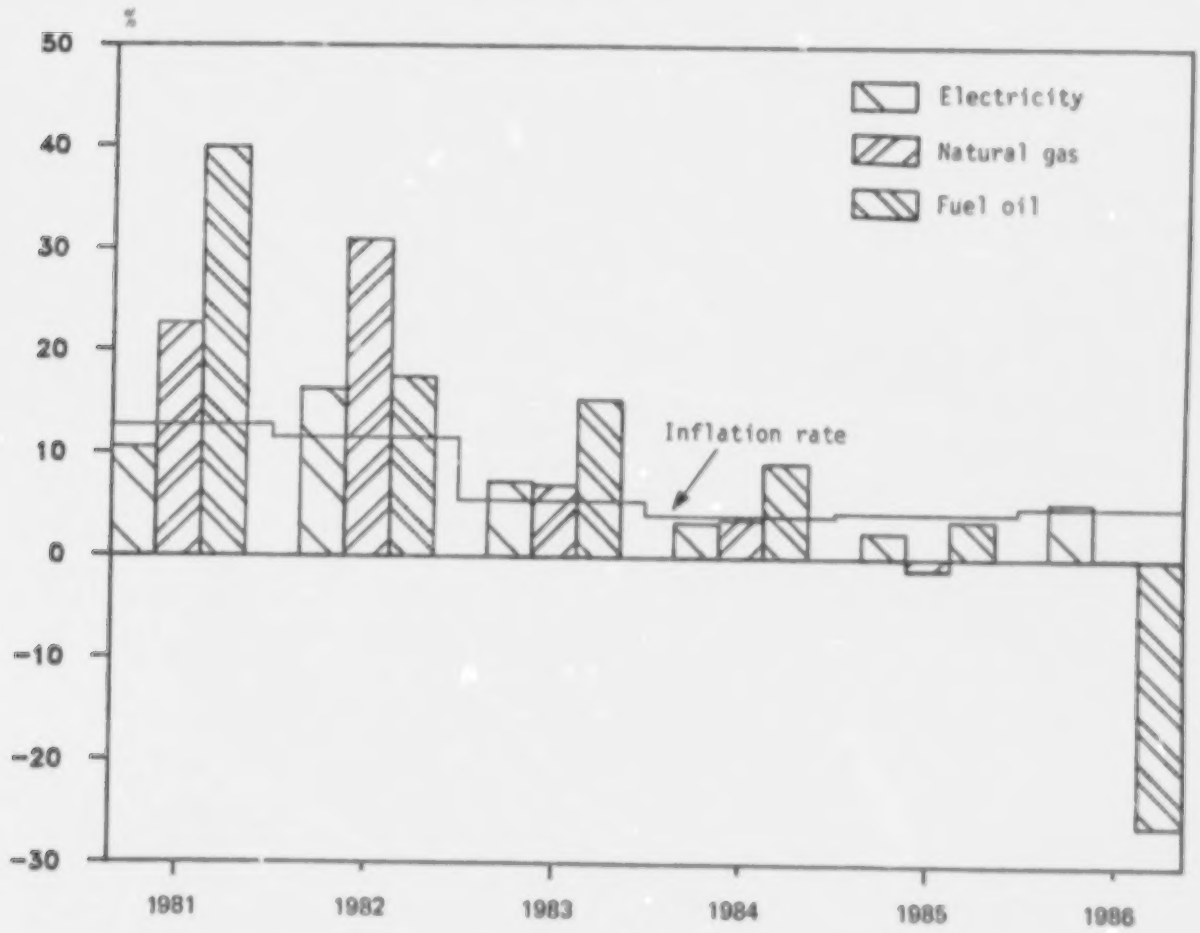
Figure 6 - **Changes in Payroll**



Limitation of Rate Increases

The gradual decline in average Hydro-Québec rate increases over the last four years, from 16.3% in 1982 to 7.3% the next year, then to 3.4%, 2.5% and 5.4% in 1986, reflects the changes in prices of other forms of energy. Average rises in the prices of natural gas and fuel oil went from 23% to 0% and 40% to -26% respectively between 1981 and 1986. They also reflect the desire of the company to maintain its competitive position and support sales efforts for disposing of surpluses. These objectives were achieved, but the falling dollar and oil prices have resulted in a substantial decline in net income and caused the capitalization ratio to fall below the desired figure of 25%.

Figure 7 - **Average Increases in Energy Prices**

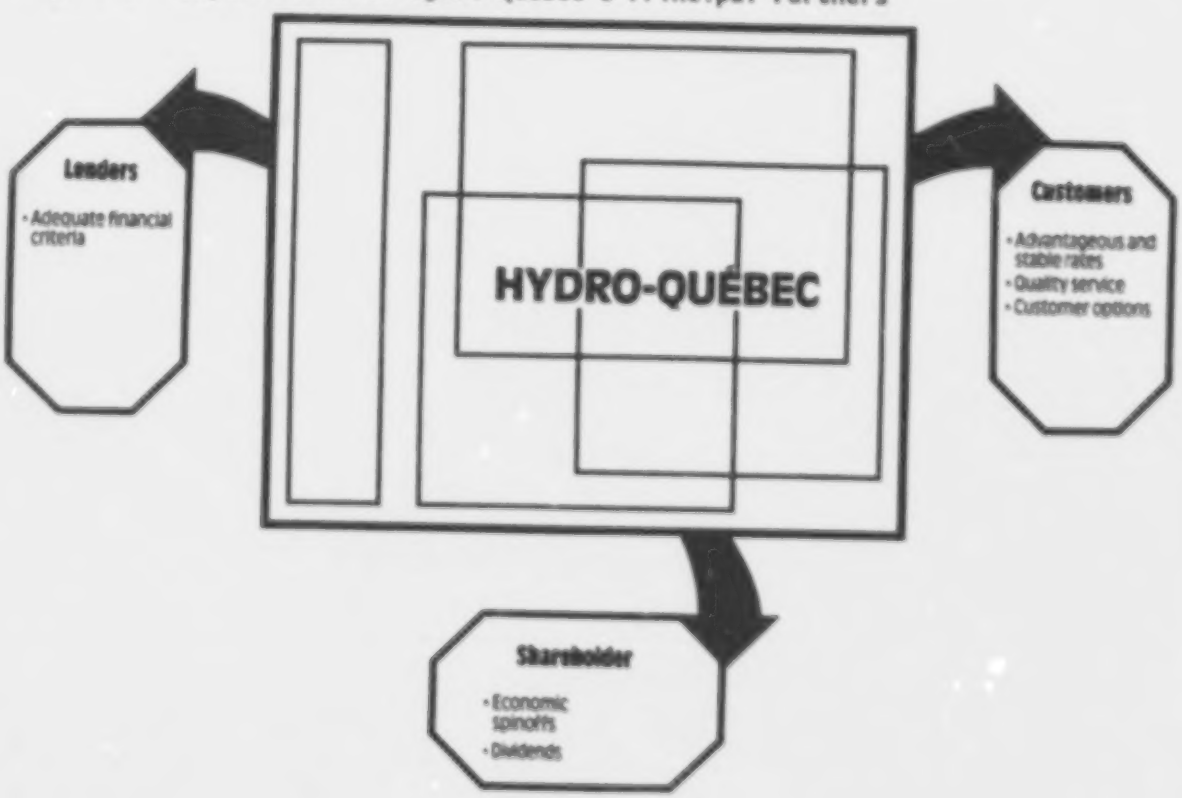


2.2 The Goals of Long-term Development

Parallel to the actions to restore the situation that characterized Hydro-Québec's **short-term strategy**, which will continue until the 1990s, the company began to devise its **long-term orientation**. The corresponding strategies should allow an optimum response to the major orientations for the development of Hydro-Québec's principal activities: expansion of the Québec and export markets to maximize the advantage of hydroelectricity, progressive development of large projects and, ultimately, diversification.

These long-term orientations should allow electricity to remain the major asset it has been for Québec since the start of the twentieth century. It is the responsibility of Hydro-Québec, with the collaboration of its employees, suppliers and other interested parties, to satisfy the expectations of its principal partners: foremost of these are its customers, the government as shareholder and owner on behalf of all of Québec, and finally the investors, who lend the company the large amount of capital it needs.

Figure 8 - **Expectations of Hydro-Québec's Principal Partners**



The Partners' Expectations

As a public utility, Hydro-Québec has a duty to offer its clientele advantageous and stable rates and quality service. It must also diversify its products in order to provide customers with choices and opportunities to reduce their energy costs.

To the government shareholder which determines the mission of the company, Hydro-Québec is accountable for its actions. It is the government which must approve its rate policy, making sure that the supply of electricity meets the criteria of sound financial management, especially with respect to the debt which it guarantees. As a government, it must also oversee the availability and quality of service to the public and its important economic spinoffs. These spinoffs are mainly the result of the investment and operating expenses linked upstream to the generation of electricity and downstream to the advantages users obtain from the marketing programs and advantageous rates. Finally, Hydro-Québec is also called upon to make its contribution to the wealth of society through an adequate rate of return on its shareholder's equity, a criterion which allows it to benefit from loans at attractive rates from its lenders.

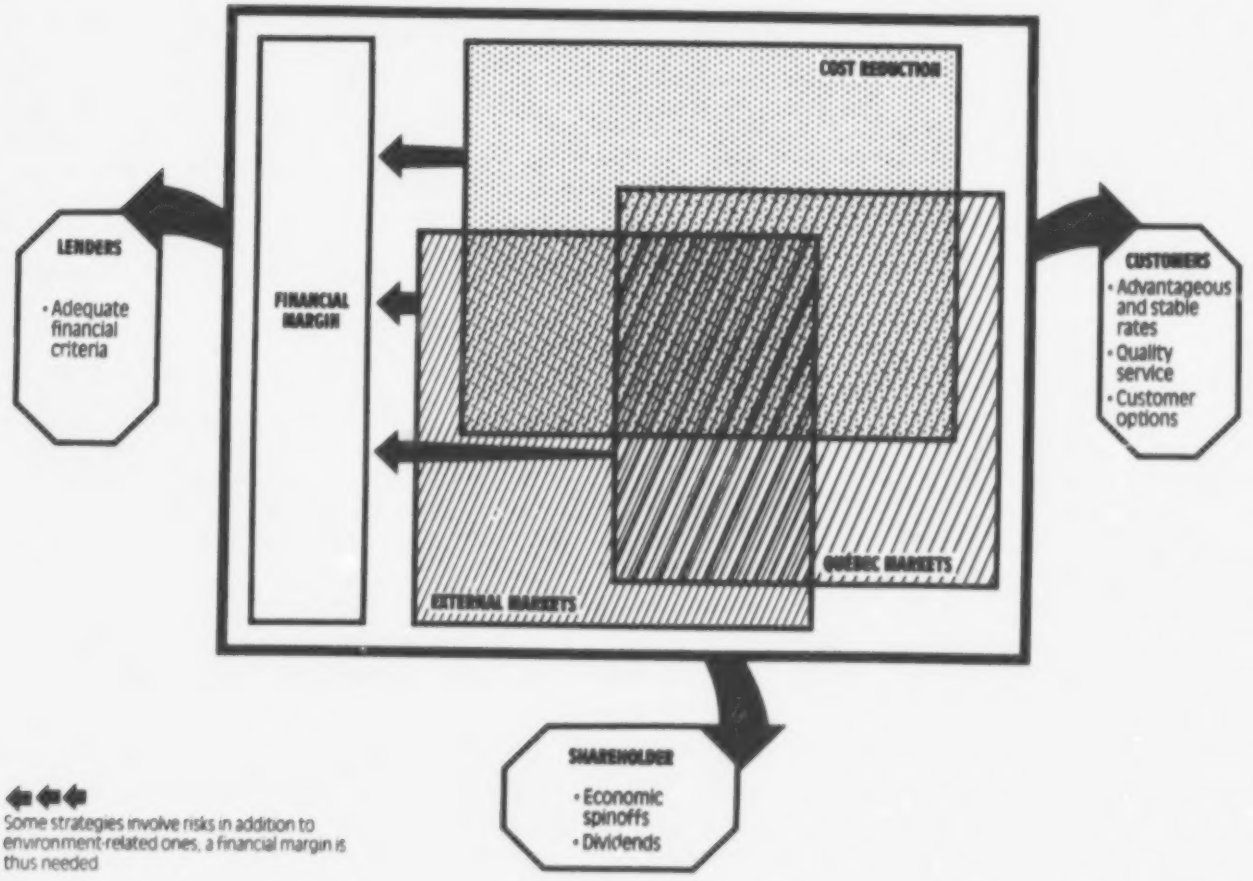
The Main Concerns: Market Development and Cost Reduction

It is the expectations of all these partners that underlie the fundamental concerns of the company when seeking to plan its long-term development. The development of Québec and external markets are two of the company's main concerns. Since Québec has abundant hydroelectric resources, for which Hydro-Québec in a sense serves as trustee, and since the development of this resource exerts a pull on the whole economy, there is every benefit in developing electricity markets by various strategies from the perspective of stimulating economic growth.

Like every other company, Hydro-Québec must be as efficient as possible and cost reduction is therefore a major concern. Here too, various cost reduction strategies will make it possible in the long term to allow advantageous rates for customers and increase the cost-effectiveness of the use of facilities. This in turn means a better return on investment and where possible, dividends that constitute revenues for the Québec government.

Finally, characteristic of the strategies recommended by Hydro-Québec in its development plan is how they are interrelated and the fact that some respond to several major concerns at the same time. The rate policy, as will become clear below, is crucial in this respect. It is at the core of Hydro-Québec's present concerns because it can encourage the efficient use of electricity and improve our ability to compete on external markets.

Figure 9 - **Hydro-Québec's Principal Concerns to Meet The Expectations of Its Partners**



⇐⇐⇐
Some strategies involve risks in addition to environment-related ones, a financial margin is thus needed

Risks and Financial Margin for Maneuver

In addition to the expectations of its principal partners and the major concerns of cost reduction and market expansion which result from them, one of the long-term concerns of Hydro-Québec is risk management. The imbalance in which the company has been plunged for the last few years is a very good illustration of the risks to which it is increasingly subject. The risks are to some extent external, such as water conditions, exchange rates, economic activity and the demand for and price of fuels. These are the subject of strategies intended to reduce their impact on revenues and expenses. But they can also come from Hydro-Québec's own strategies, introduced to reduce its costs or increase its markets.

Generally, by the end of the century Hydro-Québec will be in a situation in which the risks that confront the company will be larger than in the past. It therefore becomes essential to create enough financial margin for maneuver. This is needed to maintain stable rates, i.e. growing at a rate close to that of inflation, to avoid subjecting its customers to the impact of shocks faced by the company.

To develop hydroelectric generation harmoniously with all its partners for the benefit of Québec society and to be able to cope with the chief risks are the goals Hydro-Québec has now set for its long-term development.

3. THE EXTERNAL ENVIRONMENT

Although Hydro-Québec does have some flexibility, the company remains dependent on its environment. There are a number of external variables that directly affect its situation without the company being able to react to them, at least in the short term. Changes in prices of competing energies quickly impact revenues from electricity sales for the supply of dual-energy systems and boilers, as well as some export revenues. These sales accounted for about 20% of total revenues in 1986. Furthermore, revenues generated by sales of firm electricity to the industrial sector are highly susceptible to the unpredictable aspects of economic growth. Fluctuations in these variables of the economic and energy environment have a short-term influence on more than 40 % of company revenues.

The expenses most sensitive to the external environment are obviously interest expenses and exchange losses on capital borrowed in foreign currencies. With more than $1 billion of annual interest payments in American dollars and more than $100 million in other currencies, representing a little less than 30% of total expenses in 1986, the Canadian dollar exchange rate is a constant concern, particularly when repayments of principal in foreign currencies are added to interest payments. The exchange risk remains important, despite the fact that it is partially offset by the American dollar revenues the company earns from its exports of electricity to the United States. Furthermore, interest rate movements directly affect interest expenses engendered by new debt and floating-rate debt.

Finally, inflation affects all the company's variable revenues and expenses. Its financial impact is especially strong, however, on the fixed interest rate expenses associated with older debt. In a period of accelerating inflation, fixed interest rate expenses become increasingly easy to bear, but the opposite occurs in periods when inflation is slowing down.

Since, as can be seen, Hydro-Québec is very vulnerable to variations in the external environment, the probable changes in these outside variables must be predicted as accurately as possible. Economic forecasts are used mainly to predict demand for electricity and define the financial framework. In the very short term, forecasts are situation-dependent, while in the long term, they tend to be structural, based on projections of major trends in systems. Since it is impossible to predict the date and length of cyclical economic variations in the long term, long-term economic growth is shown as an average rate of growth. Economic cycles are explicitly taken into account by using alternative scenarios, which incorporate specific recession and recovery hypotheses.

In addition to economic and energy contexts, Hydro-Québec is subject to institutional changes. A number of major changes will probably affect the future of economic institutions and have an impact on Hydro-Québec activities. The principal ones are the international trade context, tax reform and the role of the National Energy Board.

Added progressively to these elements over the last fifteen years has been another decisive phenomenon: concerns about the quality of the natural and human environment. Hydro-Québec can no doubt adequately manage the environmental impacts of its construction or operating activities. But new imperatives and new expectations with respect to environmental protection and development continually modify the rules to which the company's activities and, to some extent, its future development are subject.

Ultimately, analysis and forecasting of the external environment seek to define the margin for maneuver available to Hydro-Québec in the short term in establishing and applying its management and development policies. They are also intended to find the most effective means, objectives, strategies and programs for increasing flexibility and reducing long-term vulnerability.

3.1 The Economic Environment

Since the early 1980s, economic systems have experienced major shocks. This has led to greater volatility in the external factors that affect the company. Structural modifications occurring throughout the world are responsible: anti-inflationary monetary policies resulted in extremely steep rises in interest rates, which in turn caused the 1981-82 recession. Moreover, because monetary policies are now focused on controlling money supply, interest rates have become generally very volatile. Finally, the major variations in exchange rates and the virtually constant turmoil in energy markets for the last fifteen years require continual adjustments by the marketplace. This volatility again appeared in 1986 with the spectacular fall of the price of oil.

3.1.1 North American Context

Besides the impact of the price of oil, in 1986 Hydro-Québec also experienced the impact of the fall in the value of the Canadian dollar compared to European and Japanese currencies. The abrupt decline of the American dollar in relation to these currencies in 1986 dragged along the Canadian dollar, which lost nearly 20% against the mark and yen.

More positively, American interest rates fell more than expected in 1986, as a result of the unprecedented fall in oil prices, the subsequent decline in inflation, fiscal policy intended to reduce the government deficit and the modest performance of the economy. The drop was less marked in Canada because of the greater difference in the inflation rates in the United States and Canada, due to indirect Canadian taxes. Moreover, the continued weakness of the Canadian dollar has expanded the gap between the interest rates of the two countries.

For coming years, we have assumed moderate growth in the United States in the probable scenario, because of the deficit reduction measures and the impact of tax reform. Although favorable to consumers, this reform will probably slow down investment. In all probability, Canada will be pulled in the American wake. Exports should increase slightly, in view of the modest growth of our trading partner. In addition, investments should not be a driving force, because of the depressed state of the energy sector.

Likewise, the scenario adopted contains the risk that the North American economies may experience some setbacks in the coming years. If American tax reform causes a major drop in corporate investment and if the reduction in the trade deficit does not materialize, the American economy may find itself in a recession in 1987. Canada would then experience a major slowdown. To these downside factors are added those associated with the nature of the coming Canadian tax reform and the persistent threat of protectionist measures from the United States.

The probable, if slight recovery in the price of certain raw materials, and the devaluation of North American currencies compared to others will result in a slight increase in the general inflation rate. However, wage settlements that are still moderate and modest economic growth should keep inflation relatively low. Interest rates should increase slightly, and the difference between Canadian and American rates become smaller as their respective inflation rates become closer together. The Canadian dollar should stabilize compared to the American dollar, but will remain under pressure in coming years because the elements of uncertainty, such as a problematic trade balance and unfavorable terms of trade, are likely to improve only slowly. Likewise, the Canadian dollar will continue to depreciate against European and Japanese currencies, in the wake of the American dollar. This depreciation may continue if there is a serious slowdown in the United States. On the other hand, in such a scenario, interest rates, especially in the short term, may be lower than those projected in the probable scenario.

The Long Term

In the longer term, the North American economy should be able to maintain moderate growth. The restructuring of industrial sectors encouraged by deregulation and a more conservative monetary policy put the economy on a better foundation for growth than that prevailing at the end of the 1970s. However, two constraints will continue to exert their influence on economic activity. The tax burden will probably continue to grow as part of government deficit control measures. And real interest rates remain above historic levels because of the inadequate level of savings in the United States and the higher risk premiums demanded by investors as protection against the vagaries of monetary and fiscal policies and the potential rekindling of inflation. The long-term outlook for inflation remains unclear because pressure on prices might result from the reabsorption of the substantial imbalances now observed in the commodity markets.

Finally, in the long term, the Canadian dollar should strengthen in comparison to the American dollar with the recovery of raw material prices. But government control of the deficit, the inflation rate differential between the two countries, protectionist measures and the continued depreciation of the American dollar compared to the European and Japanese currencies are negative factors that increase its vulnerability.

3.1.2 The Québec Economy

Again in 1986, Québec economic activity proceeded at a relatively rapid pace, slightly outperforming the levels predicted in last year's plan. Contrary to all expectations, construction did very well, with more than 50,000 housing starts, the highest level since the mid 1970s. Over the last two years, residential housing has been very active, which has resulted in good growth of Hydro-Québec sales in the domestic market. Nevertheless, like its trading partners, Québec can expect to experience a slowdown, expressed as average growth of 2.8% between now and 1989. However, major additions to capacity in primary metals in 1986 and in pulp and paper in 1987 will result in greater activity in these two industries. Still, the likelihood of a recession in the United States could affect Québec rather severely. This risk has been incorporated in the weak demand scenario, in which drops in production have been assumed for Québec's exporting industries in 1987.

The Long Term

After 1989, an estimate of the potential that can be achieved by the Québec economy suggests a growth rate of 2.7% per year until 2006. This scenario is based on a number of assumptions, the most important of which can be summarized as follows: a net slowdown in demographic pressure from the population of 15 year olds and over, especially after 2001; increases in Québec's ability to compete stemming from sustained growth in productivity, maintaining major trading opportunities. However, uncertainties about future developments in these areas, as well as the international situation, suggest a likely range of long-term growth for the Québec economy between 1.9% and 3.2%.

The most important sources of growth will be mainly in sectors that look outwards, because of the expected low growth of the population. Moreover, analysis of underlying trends in the Québec economy indicate that the growth in demand for electricity will be increasingly dependent on a few industries, given the gradual saturation of the residential market and, to a lesser extent, the tertiary sector. In this circumstance, it is interesting to take a look at the expected growth of the industries that are most important for Hydro-Québec.

Pulp and paper mills are overall Hydro-Québec's largest industrial customer. They accounted for more than 30% of firm sales of electricity to industry in 1986. Sales of electricity to this industry will depend on the growth of production but also on the penetration of new technologies that are heavy consumers of electricity.

In the long term, output of Québec's pulp and paper mills, measured in tons, should grow by 1.3% per year, as in last year's forecast. Although Québec mills will remain relatively well positioned in terms of markets and ability to compete, two factors will limit their potential: the uncertain outlook for Québec forest reserves of soft wood, the main source of wood fiber, and long-term growth in American consumption of papers at a moderate annual rate of 2%.

The smelting and refining industry for metals such as aluminum accounted for more than 17% of Hydro-Québec's firm electricity sales to industry in 1986. In the next twenty years, Québec primary aluminum production capacity should increase by nearly 75%. This forecast is lower than last year's, given that the prospects for consumption of primary aluminum appear weaker.

Because of much more fierce competition from other metals and even more from plastics, analysts are projecting world consumption of primary aluminum to grow at a rate approaching 1% per year until the end of the century, or one half of what was projected only recently. However, because of present world excess capacity, the majority of the most inefficient smelters will be closed by the beginning of the next decade, and primary production facilities are likely to relocate to places where the price and availability of energy is an important asset. In this context, Québec may supply about 10% of world primary aluminum needs, as it did in the 1960s. Moreover, a facility for magnesium, one of the metals competing with aluminum, has been integrated in the reference scenario, to be commissioned in 1989.

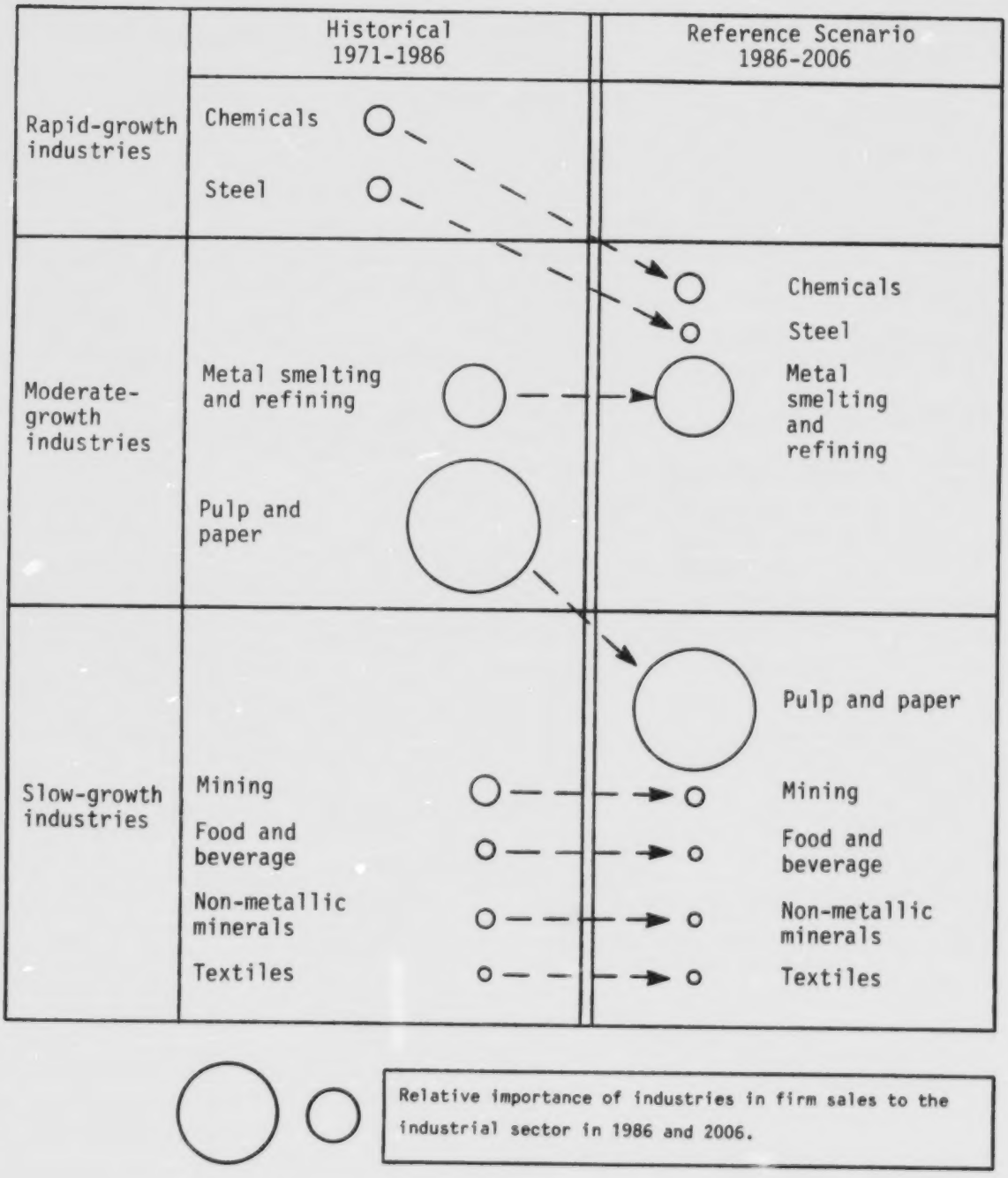
Table 1 - Main Economic Parameters (in %)

	Historical	Estimate	Forecast		
Parameters	**1985**	**1986**	**1987**	**1988**	**1989**
Québec real domestic product	4.3	3.3	2.8	2.8	2.8
Consumer price index	4.0	4.1	4.4	4.7	5.2
Interest rates on bonds for 10 years and more					
- Canadian government	11.1	9.3	9.5	10.2	10.0
- US government	10.8	7.8	7.9	8.5	9.2
Canadian-US dollar exchange rate (at year end)	0.715	0.724	0.715	0.715	0.722

Table 2 - Comparison of Economic Forecasts for 1987

Forecasts	Quebec real domestic product	Consumer price index	10-year Canadian government bond interest rates	10-year US government bond interest rates	End of year Canadian-US dollar exchange rate
Average of principal forecasters	2.8	4.2	9.2	7.7	0.709
- Upper quartile	3.0	5.2	10.3	8.7	0.734
- Lower quartile	2.3	2.8	8.6	6.6	0.686
Hydro-Québec	2.8	4.4	9.5	7.9	0.715

Figure 10 **Distribution of Industries that are Heavy and Moderate Users of Electricity According to Their Rate of Economic Growth**



3.2 Energy Environment

The situation of various energy suppliers, like Hydro-Québec, was profoundly affected by the market disequilibrium in the early part of the decade resulting in the collapse of oil prices in 1986. The volume of surpluses created a buyer's market while intensifying competition among suppliers. Internationally, the loss of price control by OPEC appears to some unlikely to be reversed for several years. In Canada, the deregulation of oil prices in 1985 and natural gas on November 1, 1986 brought the Canadian oil industry into financial difficulties in the current context of depressed prices.

The abundance of energy sources has revived competition among energies, and Hydro-Québec must face this competition on both its domestic and outside markets.

3.2.1 Competition from Oil

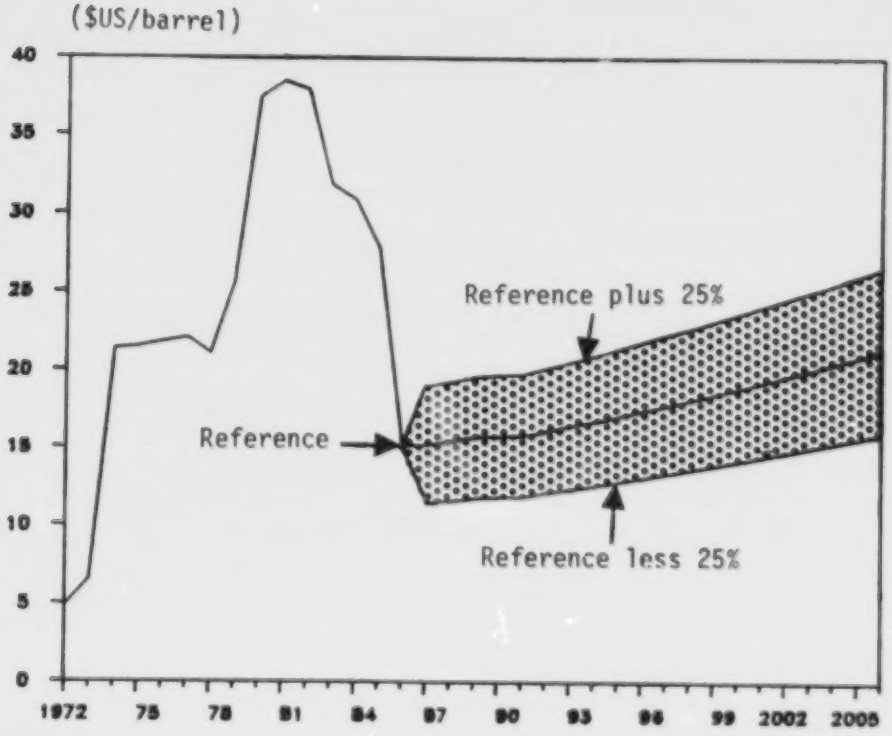
The flexibility with which petroleum products can be transported and distributed accounts for the key role of oil prices in energy trade throughout the world. Competition from oil is felt throughout the range of products obtained from refining crude oil. The fact that crude oil is refined to obtain these petroleum products has the consequence of weakening the relationship between refining costs and product prices viewed in isolation. Prices tend to gravitate around crude oil prices but are affected by the supply and demand relationships applicable to each of the products. For example, the price of bunker oil, while very variable, is usually some 15 to 20% below the price of crude oil. As a result, refiners' profits must come from the sale of light fuel oil, gasoline and other refined petroleum products.

3.2.2 Crude Oil and Petroleum Products

The loss of the power of OPEC on the international market, followed by the adoption by Saudi Arabia of a policy of maintaining market share that would ensure adequate revenues, and the deregulation of fuel prices in Canada in 1985 result in great uncertainty about the future of prices on markets served by Hydro-Québec. However, it appears that a new energy environment, characterized by prices at last 30% lower than those of only 2 or 3 years ago, will be the rule for several years.

In the 1986-1988 Development Plan, Horizon 1995, Hydro-Québec used as reference price for light crude a collapse scenario of US$20/barrel for the first years, with the possibility of even steeper falls. In this plan, the reference scenario used assumes a slight rise in the price of light crude from US$ 16 in 1987 to US$20 in 1991, because of a recovery in demand. Thereafter, the risks of new control by OPEC increase, so a real rise of 2% per year for the next decade is projected.

Figure 11 - **Scenarios for the Price of Light Crude Oil (WTI*)**
(In constant 1985 dollars)



* WTI: West Texas Intermediate

3.2.3 Competition from Natural Gas

Oil prices and surpluses of natural gas in North America have created a depressed climate for gas prices. The November 1, 1985 agreement on natural gas prices resulted in special marketing contracts in 1986 that benefited a few major users. Since the complete deregulation of Canadian natural gas prices on November 1, 1986, discounts have multiplied and been addressed to a larger market, especially the industrial and commercial sectors. The impact on the residential sector should remain small, however, and will not offset the sales tax on heating fuels in effect since May 1986.

Export price levels are a critical variable in determining the scale of any future drop in Canada. Producers are reluctant to reduce their Canadian prices if they have more attractive opportunities on export markets. On this basis, drops in price in eastern Canada result essentially from the alternatives in western Canada, where prices fell sharply in 1986, tending to favor large users.

Thus, with respect to forecasting the price of natural gas, the weakness of energy markets and fighting among producers for outlets following deregulation have had a somewhat depressive effect on prices that is difficult to quantify at this stage. Compared to the price of $4.06/Mcf (thousand cubic feet) in effect before November 1, 1986, discounts of the order of $0.20/Mcf are expected for the residential sector, $.60/Mcf for the commercial sector and $.60 to $1.30/Mcf in the industrial sector, depending on consumption volumes. These discounts will be available at different dates, depending on the nature of the agreements and the implementation of rate revisions by gas distributors.

In the long term, prices in the west should be aligned with those of bunker oil and regain the ground lost because of the battles between gas producers. Current natural gas prices in the west simply no longer justify exploration and exploitation of gas deposits, which will result in catching up with oil prices. In eastern Canada, natural gas prices are much less competitive with oil in the short term, because of the high costs of transport between Alberta and Québec and between Texas and New England.

3.2.4 Competition from Coal

Coal pricing affects Hydro-Québec sales on export markets. In the long term, coal is an oil-replacement fuel. However, in the current economic context, some of the coal market share has been captured by oil, which should have a short-term stabilizing effect on oil prices.

The growth of world coal trade since 1982-1983 has been the result of the rise in oil prices in 1979-1980, one of the major events of recent years. During this period, Australia supplanted the United States as the prime coal exporter, gaining primarily the Japanese market. The loss of position of the United States is due to internal demand, the strength of the American dollar on exchange markets and problems at American ports in accommodating large cargo ships used in this trade. The United States has become the second largest exporter of coal, serving mainly Europe, in competition with South Africa and Poland. Colombia may become a major exporter in coming years.

3.2.5 Electricity and Competing Fuels in the Québec Market

The drop in oil prices has weakened the competitive position of electricity on the residential heating market. Except for high efficiency systems, natural gas is generally more expensive than electricity. The sales tax on gas has contributed to maintaining the advantage for electricity.

For medium and heavy consumers in the commercial and institutional sectors, the surplus electricity and dual-energy systems offer opportunities for substantial savings. However, a number choose all-electric, which is generally more expensive to use but allows full benefits from the advantages of electricity and savings on construction costs.

In the industrial sector, comparisons are more difficult because a whole range of elements other than price influence energy choices. For example, firm electricity is in heavy demand as the result of greater automation by Québec industry, despite a higher price than natural gas. The explanation of this phenomenon is mainly the space savings and productivity gains associated with the use of electricity.

In 1985, Hydro-Québec created a program for promoting and developing electrotechnologies in industry. Because of the gains in efficiency and productivity obtained from using high-performance electrotechnologies, electricity rates become competitive with those of fuels. This program will allow the transition from a period of surpluses sold at extremely low prices to a period of expanding clientele for firm electricity because of its general advantages.

Until 1988, surpluses of electricity will continue to be sold in competition with the cheapest sources of hydrocarbons on the market: fuel oil and interruptible natural gas. The availability of these surpluses after the contracts expire will depend on water conditions and differences between forecast and actual sales.

Table 3 - **Competitive Positions in the Residential Sector**
(Prices at the beginning of 1987)

Type of System	Price of electricity = 100			
	Fuel Oil*	Natural Gas*	Typical Case**	
			Fuel Oil	Natural Gas
Old	97 to 125	100 to 133	115	118
New	89 to 113	95 to 128	101	113
High efficiency	83 to 107	80 to 113	96	98

* Consumption equivalent to 26,000 kWh and 10,000 kWh respectively, for the lower and upper limits. The reference efficiencies vary according to the type of system from 60% to 75% for fuel oil and from 67.5% to 90% for natural gas; electricity 100%. Includes maintenance costs and the sales tax on electricity; does not include the cost of purchasing and installing the heating system.

** Average consumption for heating a single family dwelling in Québec, 14,000 kWh per year or its energy equivalent.

3.3 Institutional Framework

Recent years have been marked by an interest structural reforms in the institutions that govern economic activity. The future of Hydro-Québec will depend substantially on how these institutions adapt to the new priorities and needs.

3.3.1 Trade Liberalization

Major changes in Hydro-Québec's commercial environment may result from current free-trade negotiations between the United States and Canada. At this time, there are no customs barriers to trade in electricity.

Because of their very high trade deficit, the Americans are seeking more balanced commercial dealings with their main trading partners. In this regard, recent developments in American legislation on international trade have made American standards the reference criteria for the legitimacy of foreign trade policies. Thus, an exporting company which accepts an inadequate return on equity or takes advantage of more permissive environmental legislation than that in effect in the United States could find itself treated as a subsidized company.

These discussions should not compromise the fundamental orientations of the present development plan, to the extent to which they comply generally with the standards of American electrical utilities. Thus, in both Québec and external markets, the main Hydro-Québec objectives are to recover production costs and obtain an adequate return on equity, according to the risk inherent in the development of each of these markets. Moreover, hydroelectric generation respects very rigorous environmental standards, implying major investments by Hydro-Québec. Although the company is not subject to corporate taxation, it pays other taxes from which American utilities are exempt. The legitimacy of Hydro-Québec's marketing programs also appears undeniable. These programs respond to the criteria of profitability or can be justified, as in the case of electrotechnologies, by the necessity for developing long-term markets.

3.3.2 Deregulation of Electricity Exports

Other changes can be expected with respect to forms of government intervention. The necessity for relaxing regulation has been recognized in a number of sectors. In the short term, this new orientation may affect the National Energy Board, the agency which issues licences allowing Hydro-Québec to export electricity to the United States. Federal regulation of exports was the subject of an inquiry in 1986 intended to allow the establishment of new, more flexible decision-making criteria more in keeping with today's realities.

3.3.3 Legal Environment

With respect to the suit involving the contract for energy from Churchill Falls, the Supreme Court of Canada has allowed appeal by Newfoundland on its right of recall of 800 MW of power from Churchill Falls.

3.4 The Natural and Human Environment

Hydro-Québec is the North American utility most committed to the generation of hydroelectricity. The stress on water resources is of course based on general economic criteria but also on the geography of Québec. This form of generation also offers various significant advantages with respect to the natural and human environment.

However, hydroelectric generation requires the use of large areas for the creation of reservoirs (11,500 km^2 in the case of the La Grande complex and 4,350 km^2 for just the Caniapiscau Reservoir), and the diversion of rivers. This data illustrates the place that the company occupies in some regions of Québec, as well as its responsibility and role with respect to developing local resources. Likewise, the remoteness of the generation stations from where the electricity is used requires the installation of transmission lines over long distances. At this time, about 65% of Hydro-Québec's available power comes from power stations located more than 500 km from the main centres of consumption.

The transmission system as a whole consists of nearly 10,000 km of 735-kV lines and 18,000 km of lines carrying 315 kV or less. It crosses very diverse environments and nearly two thirds of its length is located in populated regions. To the problems of resource development in northern habitats are thus added problems of integration with existing and planned developments in southern Québec.

Natural resource management is a key element of the company's development. As a factor in the development of Québec, the company must integrate its activities with planning by public agencies on land use and resource exploitation.

Involved are resources that are increasingly limited in space that is increasingly restricted, especially in the St. Lawrence valley. These are areas also sought by other parties whose development goals often involve uses that compete with that of the generation and transmission of energy. Finally, these resources are increasingly subject to legislative and regulatory frameworks that are intended to ensure administration that is representative of the general interests of society, and in some cases purely and simply their protection.

All these factors tend to progressively increase the socio-economic value ascribed to both resources and land and require, as a result, new solutions to ensure more rational use. The experience accumulated by the company in planning and environmental protection, as well as the scope and number of planned installations require overall perspective on the use of the resources necessary for its construction program, needed to adjust its activities to current and future contexts. At the same time, as a partner in regional development, the company recognizes the importance of collaboration by all users.

4. REFERENCE DEMAND FOR ELECTRICITY

In this context, the reference demand for electricity means forecast demand based on the anticipated economic and energy context, the marketing programs already begun by Hydro-Québec and a general hypothesis of rate growth according to inflation. The strategies for developing domestic and external markets, which are the subject of the next two chapters, should modify this reference forecast, transforming it into the target demand used in planning, to be discussed in Chapter 7. The reference demand includes firm and surplus[1] sales of electricity in Québec and export sales of firm electricity covered by contracts already signed.

4.1 Sales of electricity in Québec[2]

Sales of electricity in Québec cover the sales of firm electricity and sales of surplus electricity mainly satisfying the demand for steam in the industrial sector.

4.1.1 Sales of Firm Electricity in Québec

From 1983 to 1986, sales of firm electricity in Québec grew at 7% per year. This growth was mainly due to the number of conversions to electricity of homes heated by oil, the substantial increase in electricity's share of the commercial and institutional market and the recovery of sustained industrial activity in almost all sectors of the economy after the 1982 recession. The company's marketing programs fully contributed to the recovery in demand. The dual-energy program alone caused nearly one half the conversions in the residential sector.

1 Under the sales programs, implemented to dispose of the surpluses, most of these are firm sales.

2 The detailed load forecast assumptions are presented in a separate report entitled *La demande d'électricité au Québec, horizon 2006.*

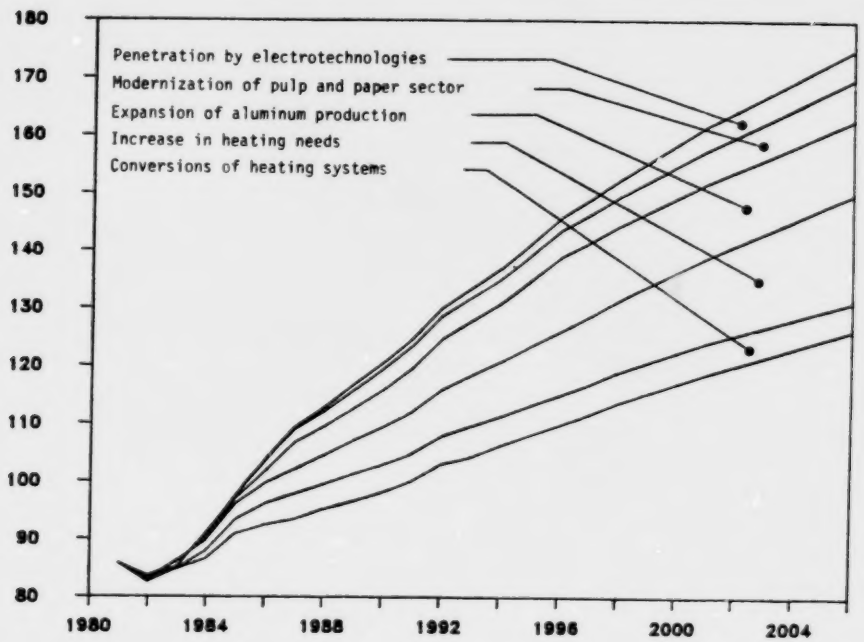
Table 4 - **Reference Scenario**
Forecast of Sales of Firm Electricity
by Hydro-Québec in Québec (in TWh)

Sectors	Historical						Forecast								1986-2006 %
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1996	2001	2006	
- Domestic and farm	31.5	32.1	32.5	36.0	38.4	40.5	41.2	42.1	42.8	45.0	46.1	51.6	55.7	58.6	1.9
- General	19.2	19.2	19.7	19.8	20.8	22.2	23.4	24.3	25.4	25.6	26.5	30.6	34.9	39.3	2.9
- Industrial	31.5	28.7	29.3	31.4	34.4	36.5	40.9	42.5	44.5	47.0	49.3	61.8	69.4	75.1	3.7
- Other	3.6	3.5	3.6	3.8	4.1	4.2	4.4	4.2	3.9	2.9	2.7	1.9	1.7	1.9	-3.9
Firm Sales in Québec	85.8	83.5	85.1	91.0	97.6	103.5	109.9	113.0	116.6	120.5	124.7	145.8	161.7	175.0	2.7
Annual Variation in TWh	1.1	-2.3	1.6	5.9	6.6	5.9	6.4	3.1	3.6	3.9	4.2	4.2	3.2	2.7	
in %	1.3	-2.7	1.9	6.9	7.3	6.0	6.2	2.8	3.2	3.3	3.4	3.2	2.1	1.6	

The pattern of past growth will be substantially different in the future. The industrial sector will take over leadership from the residential sector as locomotive for the growth of sales of firm electricity in Québec, due mainly to progress in the primary metals and pulp and paper industries.

Average annual load growth will be 2.7% from 1986 to 2006, an average 3.6 TWh per year, to reach 175 TWh. However, there will be a continuous reduction in the rate of growth because of the combined effect of demographic slowdown and the saturation of the heating market for residential and commercial units. The annual rates will be 3.8% from 1986 to 1991, 3.2% from 1991 to 1996, 2.1% from 1996 to 2001 and finally 1.6% from 2001 to 2006.

Figure 12 - **Main Factors in Demand Growth**
Sales of firm electricity in Québec

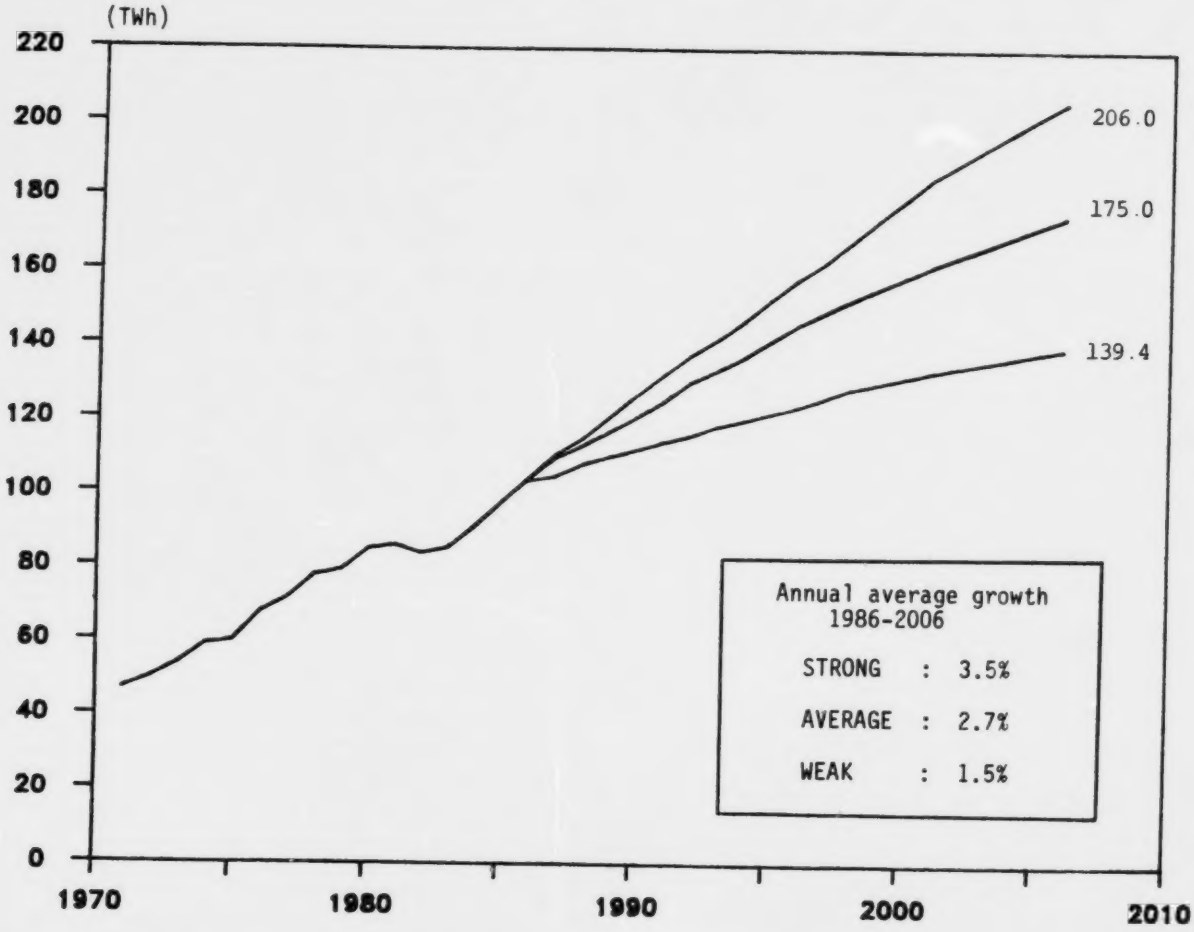


Compared to last year, where the forecast stopped in 2001, the 1985-2001 rate of growth has been revised from 3.0% to 3.2%, which represents an increase in sales of firm electricity of 4.9 TWh in 2001. This increase essentially reflects an upward revision of the number of households and the greater growth in the primary metals and pulp and paper industries.

Hydro-Québec's forecast of 2.7% from 1986 to 2006 falls within a growth range from 1.5% to 3.5%. This makes it possible to estimate the impact of variation in demand on the company's planning and development activities. The range is slightly asymmetrical with respect to the reference scenario, because the risks of decline in some markets are larger than those of a rise. Moreover, several of our markets are approaching saturation.

Improvement in the efficiency of heating systems by substantial penetration of heat pumps, for example, seems more likely than an increase in unit consumption of heating. The growth in industrial demand will depend essentially on major consumers of electricity. The risks of the world economic and energy scene, the fierce international competition for these markets and the changes in Canadian exchange rates are all elements that might delay the introduction of heavy consuming industries used in the forecast.

Figure 13 - **Scenarios of Sales of Firm Electricity by Hydro-Québec in Québec**



The strong demand scenario implies more sustained economic growth in which Québec participates, more favorable demographic growth, and greater penetration by electricity on all markets. In the weak demand scenario, world economic growth is less favorable for Québec exports of products and services, demographic growth is affected, essentially by immigration, and electricity faces greater competition from other fuels on all the competitive markets.

Power needs will increase by 2.6% from 1986 to 2006, compared to 3.5% from 1986 to 1991. The rapid growth of the smelting and refining sector between 1986 and 1996 will bring improvement in the utilization factor from 57.1% to 58.3%, after which it will drop to 57.5% in 2006, because of a decline in the number of housing units with dual-energy heating. Furthermore, the smelting and refining sector will grow less quickly after 1996.

Table 5 - **Québec Priority Needs***

	TWh	MW**	Load Factor***
1981	98.6	19,700	57.1%
1986	117.8	23,570	57.1%
1991	142.1	27,980	58.0%
1996	165.5	32,320	58.3%
2001	182.6	35,970	58.0%
2006	197.3	39,190	57.5%

* Priority needs include firm sales of electricity in Québec, deliveries as per agreement and corresponding losses on the power system.

** Winter peak load starting at the end of the year given.

*** Corresponds to the ratio of annual energy to load at the system peak multiplied by the number of hours in the year.

4.1.2 Sales of Surplus Electricity in Québec

Sales of surplus electricity should reach 13.3 TWh in 1987 and 1988. Agreements signed with more than 400 customers as part of the electrical boiler program represent installed capacity of 3,207 MW.

After 1988, in the general sector, about 0.7 TWh of these sales should be transferred to the dual-energy rate and be treated as firm sales. In the industrial sector, a portion of the market might eventually take firm supplies, with the introduction of productive electrotechnologies for certain processes. The sales of surplus electricity after 1988 will be dictated by run-off levels, changes in firm sales in Québec and export sales.

Table 6 - **Sales of Surplus Electricity in Québec** (in TWh)

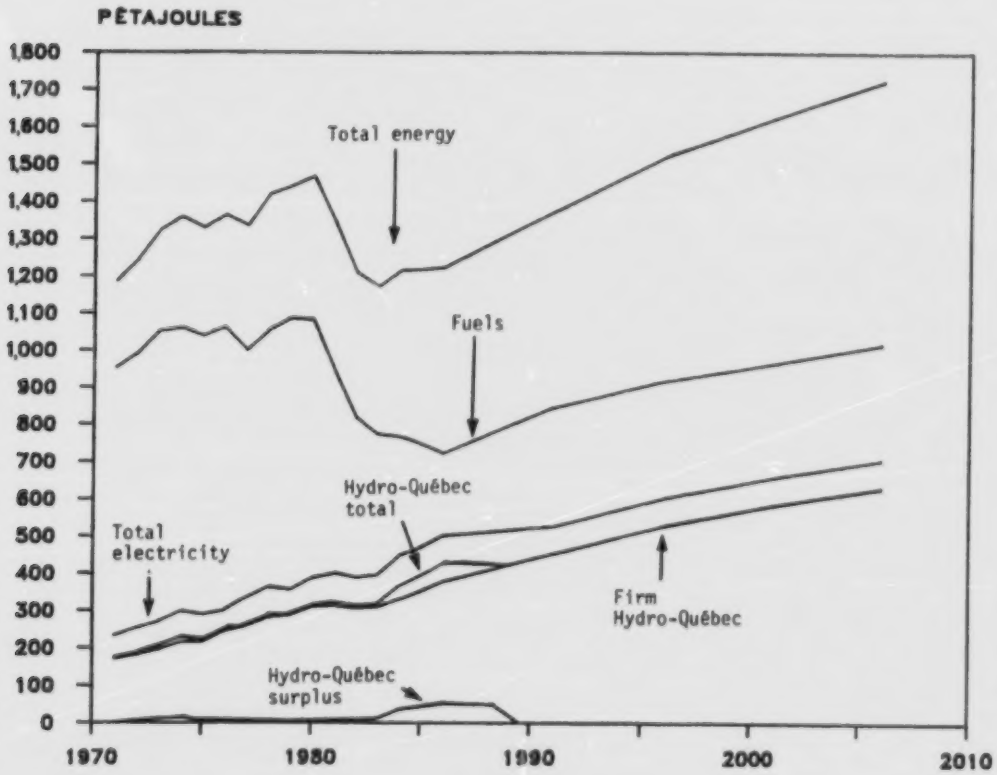
Sectors	Historical						Forecast		
	1981	1982	1983	1984	1985	1986	1987	1988	1989
- General	0.0	0.0	0.0	0.9	1.4	1.4	1.4	1.4	0.0
- Industrial	1.8	1.6	2.4	7.0	9.5	11.1	10.9	10.9	1.8
- Neighboring systems in Québec	0.9	0.6	0.6	2.0	1.2	1.2	1.0	1.0	0.0
Surplus electricity	2.7	2.2	3.0	9.9	12.1	13.7	13.3	13.3	1.8*

* Sales of surplus electricity in Québec in 1989 may vary, depending on runoff conditions, the price of surplus electricity for export and growth in firm sales of electricity in Québec.

4.1.3 Electricity in Québec's Energy Mix

The drop in oil prices in early 1986 has lowered expectations about future oil price rises, and this should substantially modify behavior with respect to energy. Given the significance of transportation in energy use and the strong growth in oil projected for this sector, the share of electricity in energy use should not surpass that of oil before the end of the century. Energy consumption in Québec should grow by 1.7% between 1986 and 2006, and the share of electricity stabilize around 40% during this period. The long term outlook for gas is to stabilize at around 16%.

Figure 14 - **Consumption of Conventional Energy in Québec**



4.2 Sales of Firm Energy for Export and Hydro-Québec's Total Contract Commitments

The main sales of firm electricity for export covered by contract are now sales to the New England Power Pool for 7 TWh per year between 1990 and 2000, to Vermont for about 1.1 TWh per year until 1995, and to the New York Power Authority for 3 TWh per year until 1991.

Total contract commitments by Hydro-Québec include on Québec markets sales of firm electricity, deliveries as per agreement and sales of surplus electricity in Québec (most of which are guaranteed) and on the export markets, sales of firm electricity included in contracts.

Besides these contract commitments, the company expects to sell some 156 TWh of surplus electricity on export markets by 1995. This amount may vary, depending on firm sales of electricity in Québec and runoff levels. The breakdown of these sales appears in the Table "Balance of Supply and Demand for Electrical Energy", in Chapter 8.

Table 7 - Hydro-Québec's Contract Commitments (in TWh)

	1987	1988	1989	1990	1991	1996	2001	2006
Salesof firm electricity in Québec	109.9	113.0	116.6	120.5	124.7	145.8	161.7	175.0
Sales of surplus electricity in Québec*	13.3	13.3	1.8	-	-	-	-	-
Sales of firm electricity for export	5.1	5.1	5.0	6.8	11.5	7.5	-	-
Total	128.3	131.4	123.4	127.3	136.2	153.3	161.7	175.0
* Most of these sales are guaranteed.								

5. QUÉBEC MARKETS

5.1 Review of the Situation

In 1982, Hydro-Québec rapidly put together a series of vigorous marketing programs to dispose of major energy surpluses. Since 1985, the period of spills and sales programs that resulted from it have almost all ended. Last year, Hydro-Québec's marketing plan already sought to develop and maintain durable markets by allowing Québec customers to benefit from the comparative advantages that hydroelectricity can offer. For the period considered, it structured its activity around three main objectives: improving the quality of service, both technically and with respect to marketing practices; promoting load management; and developing industrial markets. All the means implemented were also to help achieve the governmental objectives of economic development. The programs of recent years were successful substantially beyond their stated goals. Table 8 provides a summary of the situation.

Table 8 - Sales Associated with Marketing Programs (in TWh)

Marketing Programs	Number of customers at the end of 1986	1983	1984	1985	1986	1987	1988	1989	Cumulative 1983-1989
Dual Energy									
- Single units	127,600	0.2	1.0	1.7	1.7	1.6	1.4	1.3	8.9
- Multiple dwellings	20,600*	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.5
- General	6,500	---	---	0.1	1.0	1.5	1.7	2.4	6.7
Rate Discounts to Industries**	586	0.1	0.8	2.7	6.3	9.7	10.3	11.5	41.4
Boilers	406	3.0	9.9	12.1	13.7	13.3	13.3	1.8	67.1
Electrotechnologies	N/A	---	---	0.1	0.2	0.5	0.6	1.0	2.4
Other	N/A	---	---	---	0.1	0.3	0.3	0.3	1.0
Total		3.3	11.7	16.8	23.1	27.0	27.7	18.4	128.0

* The results reflect the number of dwellings.

** Rate discounts and incentive program for new aluminum smelters are reflected in these results.

To date, the dual-energy programs alone have attracted about 148,000 customers in the residential sector. This clientele, substantially the same as in 1985, allowed additional sales of the order of 1.8 TWh as in the previous year, for about $70 million in revenues. In the commercial, industrial and institutional sectors, progress has been striking: in 1986 alone, the number of customers joining this program will be on the order of 3,800 and the contracts involve about 1,300 MW, which brings the cumulative total for these three sectors to 2,000 MW.

In the industrial sector, Hydro-Québec in 1986 studied the possibility of expanding its interruptible power agreements, until then limited to 500 MW. It advanced studies, re-evaluated the market potential and undertook consultations with customers by sector. It has become increasingly evident that there is a an additional potential of about 1,500 MW in this area, as indicated last year. Action to take advantage of this potential may well be undertaken.

The electrotechnology program, launched in 1985, resulted in the installation during 1986 of new processes corresponding to consumption of 200 GWh in 1986, as replacement for fossil fuels. This consumption will reach 700 GWh in 1987. Finally, the availability of hydroelectricity made it possible to attract major industrial investments, including Aluminerie de Bécancour Inc. and the Norwegian multinational Norsk Hydro.

At this time, Hydro-Québec's marketing context is undergoing as thorough a change as it did in 1981-82. It is characterized by the saturation of some traditional market segments and increased competition from other forms of energy.

The existing residential market is substantially occupied by electricity, even in the most intensive applications like water and space heating. There remains only new construction. This does not offer as substantial growth potential as in the past, given the low growth of the population.

For all-electric heating, the commercial market is rather difficult to capture, given the competition from other forms of energy. Nevertheless, it offers an attractive potential for off-peak use of electricity, such as dual-energy heating.

The industrial market offers the best possibilities for growth in sales, because the competitive position of hydroelectricity on the North American energy market remains very good. This promotes installation of energy-consuming industries in Québec. The collapse in fuel-oil prices that occurred last year may, however, slow down the penetration of electrotechnologies.

5.2 Major Orientations of the Marketing Plan

This year's marketing plan is an extension of last year's, adapted to the competitive environment. The principles which guide it are unchanged, however:

- satisfaction of customer needs;
- contribution to the profitability of the company;
- harmonization with government policies.

The objectives and strategies presented below fall into three major areas: quality of service, selective market development and prices.

5.2.1 Service Quality

The quality of the service provided customers is vitally important. Maintaining and improving this quality are on-going goals of the company, with a high priority. To achieve them requires various programs well adapted to needs and situations.

It also necessarily implies daily activities of some 15,000 employees who, in operations and business practices, have the specific role of offering customers quality service.

Chapter 7, which discusses the operation of installations, explains the main strategies for improving the quality of electrical service, a factor which is increasingly important for a growing number of customers.

Quality business practices are essential too. In this area, Hydro-Québec is seeking to diversify its services to reflect the needs of various segments of its clientele and stimulate a real customer service approach among all its employees.

The goal of improving quality in business practices implies joint action at several levels, day by day. In this area, the best results must often come from patient and repeated actions that pass unnoticed because they are part of the everyday life of the company.

5.2.2 Selective Market Development

Hydro-Québec wishes to continue to develop the markets it considers profitable and retain those it is already supplying, increasing, if possible, their profitability by reducing the costs of supply. To achieve this goal it must, in return, offer quality products and services particularly well adapted to the needs of its clientele at competitive prices.

These new markets will completely or partially replace certain markets that are no longer profitable. That is the case of the markets that were developed essentially to dispose of electricity surpluses and avoid spills. Thus, the scale of the program to supply industrial boilers will shrink as the contracts now in effect expire. Hydro-Québec will retain only a minimum program, comparable to the one that existed before the surpluses.

Hydro-Québec will mainly be seeking to promote the use of electricity in off-peak times. By doing this, it limits the need to install new peak-load equipment and thus reduces its generating costs. This strategy will help reduce the size of rate increases for all its customers and provide a net advantage to those customers that opt for these products. By promoting off-peak production, Hydro-Québec is seeking to let its clientele fully profit from the comparative advantages of hydroelectricity.

Residential Market

Because this market is approaching saturation, Hydro-Québec will stress maintaining its existing market, without neglecting the development efforts begun in past years, especially those intended to manage demand in a way to promote off-peak use.

Since 1982, some 148,000 dwellings have adopted dual-energy heating systems. Hydro-Québec spent $120 million in grants which, combined with the Canadian Oil Substitution Program, account for a large part of the success of this program. It was thus possible to allow customers to benefit from the advantages of hydroelectricity while offering the opportunity to relieve the system of a load of 700 MW during peak periods.

This dual-energy market is a major asset in Hydro-Québec's long-term strategy. The sales of dual-energy heating occur in off-peak periods only, thus avoiding the necessity for further peak-load equipment. This equipment would be necessary if customers, lacking an adequate maintenance program, were to get rid of their oil heating system or were to choose the all-electric mode because the dual-energy mode did not offer them significant savings. On the other hand, Hydro-Québec would lose a source of revenue if customers were to decide to use oil alone.

Thus, the current condition of these systems has some inherent shortcomings that it would be appropriate to remedy.

That is why Hydro-Québec proposes two main actions intended to keep the dual-energy stock in the long term and to urge customers to use their dual-energy system in automatic mode. The first consists of establishing an adequate after-sales service. The second is offering interested customers very attractive rates so long as they heat with electricity in off-peak periods and use oil for heating in peak periods. In other words, the dual-energy rate that will be proposed will contain a marked price differential for peak and off-peak consumption. This will dissuade customers from using electricity in peak periods. It will be the customers themselves, however, who manage their consumption: they will keep a switch that allows them to select the oil, all-electric or dual-energy modes, and the heat sensor will remain the method for switching from one energy source to another.

Commercial, Institutional and Industrial Markets

In 1985 and 1986, the dual-energy program for commercial, institutional and commercial markets was quite successful. Hydro-Québec estimates that there is still an important substitution market available. However, the current situation is not very favorable. Given the collapse in oil prices, it is difficult to offer terms that are both profitable for Hydro-Québec and attractive to the customer, both in the short and long term. For the moment, the new program to begin in 1987 seeks a target clientele consisting mainly of customers whose current heating system is inefficient. If the price of fuel oil rises again, the situation would become favorable for greater substitution of electricity for fuel oil.

Between January 1987 and June 1988, Hydro-Québec has an objective of 500 MW. The program is intended to replace fuel oil while leaving natural gas the place it should have. This program will allow very profitable sales of off-peak electricity and contribute to the development of markets in sectors where the position of electricity would not otherwise be competitive.

In addition, total consumption by dual-energy customers can represent an energy reserve for Hydro-Québec which is by no means to be neglected in planning the level to maintain in its reservoirs. In case of low run-off, it would be possible to give incentives to customers to use oil exclusively for a given amount of time.

Industrial Market

The industrial market offers Hydro-Québec the greatest potential for expansion. The company will therefore devote a good portion of its efforts to this market. In addition to the dual-energy program already mentioned, Hydro-Québec will offer three marketing strategies that are specifically intended for this market: the interruptible power program, industrial expansion based on risk and profit sharing, and electrotechnologies.

Under its **Interruptible Power Program**, Hydro-Québec offers substantial rate credits to large industrial customers who agree to interruptions of service of a limited duration during particularly critical peak periods. In this way, customers can substantially reduce their electricity bill (by about 9% for the portion of consumption covered by the contract). They may reduce production costs and enhance their ability to compete on international markets in this way. For its part, Hydro-Québec reduces its supply costs.

As the result of studies conducted in 1986, Hydro-Québec proposes to expand its inventory of interruptible power and improve the rate terms associated with it. Starting in the winter of 1986-87, it will begin this process. At this time, the company already has a first addition of 200 MW, bringing interruptible power capacity from 500 to 700 MW.

In the 1996 horizon, the goal is 2,000 MW, or 1,500 MW more than in early 1986. This represents an annual credit to participating customers of nearly $100 million. Since the rate terms will be even more attractive than they are now, customers may save from 10 to 15% on their electricity bill. The program will thus offer substantial advantages to participating customers. It will allow them to reduce their costs and thus improve their ability to compete internationally. At the same time, the program allows Hydro-Québec to avoid investments in peak-load equipment of the order of $1 billion in the 1996 horizon.

Achieving this objective implies that Hydro-Québec offers the pulp and paper sector, the most intensive consumer of electricity of all, the possibility of taking advantage of the new interruptible power program. It seems clear that the introduction of thermo-mechanical processes for the production of pulp is a particularly favorable condition for the companies in this sector to take full advantage of the interruptible power program. Hydro-Québec has already begun feasibility studies with some customers in this sector and would be ready, if need be, to make a technical and financial contribution to pilot experiments.

Risk and Profit Sharing, already announced last year, will receive attention during the coming years.

The goal of this marketing strategy is to increase the share of electricity in the industrial market and to contribute to expanding Québec's industrial base. The target clientele consists of industrial customers for whom energy expenses are a major portion of production costs and for whom electricity may offer a substantial comparative advantage. These may be industries already operating in Québec or new ones which may be attracted to Québec by these programs.

Hydro-Québec in the past limited itself to offering these customers rate reductions when an installation was opened or long-term guarantees for which Hydro-Québec alone assumed the risks. In doing so, it transferred the burden of revenue shortfalls to all the company's clientele.

Since last year, the company has begun to diversify and intensify its collaboration by developing different risk and profit sharing programs. The contracts take into account the customer's method of operation, the size of the investments required by the customer, the duration of the running-in period and the economic cycles to which they are subject. The proposed clauses, including the price clauses, are adapted to the special situation of each customer.

Since 1984, Hydro-Québec has signed five contracts based on risk and profit sharing. These will represent sales of nearly 4.7 TWh per year when, in the early 1990s, the installations involved have reached full production. Another ten contracts are currently under active discussion.

The Electrotechnology Implementation Assistance Program is also in its early stages, since it was only launched in 1985. This program is intended to introduce electrotechnologies in industrial processes where electricity can be more productive than existing fuel-oil based systems. In this way, the program can also improve the competitive ability of participating customers or stimulate the installation of new industries.

Hydro-Québec is ready to join with industries and establish a solid basis for collaboration on this program. For example, it can provide technical and financial collaboration during the execution of feasibility studies and at the time that the electrotechnologies are installed.

Since the start of this $30 million program, Hydro-Québec has already committed $11 million. In the next three years, it expects to increase sales resulting from the advent of electrotechnologies to reach 1 TWh per year in 1989, which would represent annual revenues in the order of $30 million.

In addition to this marketing program, Hydro-Québec also devotes research efforts to electrotechnologies. Chapter 9 contains a discussion on the development of technology and diversification.

5.2.3 Pricing

As Chapter 12 explains, Hydro-Québec's rate-setting policy is the result of tradeoffs on several levels. It reflects the tradeoff between a search for the best price signal to give consumers and the desire to maintain rates as low as possible. It is also a tradeoff between short-term and long-term price levels, since customers wish to be sheltered from rate shocks. To achieve that implies that the company has a normal return on the capital invested and enough margin for maneuver to itself be sheltered from risks.

From this perspective, Hydro-Québec seeks within the next three years to restore its minimum financial criteria, which were respected until 1984, and in the following years, to acquire enough margin for leeway to protect the company and thereby its customers from risks. Chapter 11 discusses these financial objectives.

The rate strategy may contribute substantially to achieving these objectives. Initially, during the next three years, Hydro-Québec is seeking to obtain a return in the order of 13% on the capital invested overall in its Québec markets. In a second stage, it will seek to approach this rate of return for each of its Québec markets, to avoid cross-subsidization.

At this time, the application of the 1986 rates to sales of firm electricity results in a return of 11.4%, as Table 9 indicates.

Table 9 - Rate of Return by Rate Category (1986)

Category	Average Selling Price ¢/kWh	Rate of Return
D	4.2	1.9
G	5.5	29.2
M	4.4	27.9
L	2.8	10.5
Average	4.0	11.4

However, as can be seen, the contribution of various markets to the overall rate of return varies a great deal, depending on the rate category.

Although rate increases in the past (except 1983 and 1986) were differentiated by rate category, substantial discrepancies still exist. This results in cross-subsidization among markets. This cross-subsidization interferes with the market mechanism and gives the consumer an unrealistic price signal.

It is therefore necessary to correct these discrepancies as soon as possible, so that each market can be profitable by itself.

The following table, based on 1986 data, shows the relationship of the price paid by customers for each rate category to that required to give a rate of return of 13%.

Table 10 - **Ranking of Prices for Various Rate Categories (1986)**

Rate category	Average Price ¢/kWh (a)	Accounting Cost ¢/kWh (b)	Difference % (b ÷ a)
D	4.2	4.9	16.7
G	5.5	4.6	(16.4)
M	4.4	3.7	(15.9)
L	2.8	2.9	3.6
Average	4.0	4.1	2.5

For the residential market to be able to provide a rate of return of 13%, the average price applied to it must rise from 4.2 to 4.9 cents/kWh. This would represent an abrupt increase of the order of 17%.

Hydro-Québec has no intention of correcting the situation so abruptly. It will take the economic situation and the prices of its competitors into account, and it will therefore seek to spread the correction of the discrepancies over several years.

Hydro-Québec's rate proposals reflect this situation and are based on the guiding principles of rate-setting announced in last year's plan:

- maintain territorial uniformity of prices and treat customers with similar consumption profiles in the same way.

- gradually and to the extent possible, have rates reflect the costs of supply associated with various products delivered to various rate categories.

- facilitate the understanding and application of rates.

- take customer methods of operation into account.

5.3 Objectives and Strategies

Objective 1

Maintain personalized relationships with the various segments of the clientele in order to increase customer satisfaction and sustain efforts to maintain and development electricity markets.

Communication Strategies

1. Pursue in a more structured and better organized way dialogue with consumer associations on business practices, especially on ways to assist customers with problems making payments.

2. Continue to mobilize all Hydro-Québec personnel around the customer service approach.

3. Introduce communications systems throughout Hydro-Québec allowing customers to be warned of planned interruptions.

Sales Strategies

1. Standardize commercial practices with respect to supplying electricity.

2. Sustain marketing efforts by continuing collaboration with outside parties.

After-sales Service Strategies

1. Revise billing procedures by accelerating and regularizing billing and by the end of 1987 produce and use a new, clearer invoice that gives customers more information.

2. Introduce a mechanism for appeals and for dealing with complaints in all regions by June 1988.

3. Facilitate the signing of agreements with customers who have payment problems.

4. Throughout Hydro-Québec adapt the systems for communication and transmission of invoices and literature to people with hearing and visual impairments.

Objective 2

Achieve selective development of markets in order to be able to offer advantageous options to customers, in view of their individual needs, and in order to reduce the costs of supplying electricity.

Strategies

1. Promote the consumption of electricity during off-peak periods, either by reducing or shifting consumption now occurring during peak periods, or by developing off-peak markets.

This strategy essentially consists of three programs and one pilot project. These and similar programs have given excellent results in recent years, as was noted above. Hydro-Québec is seeking:

- to increase the interruptible power capacity to 2,000 MW in the 1996 horizon.

  During the next three years, Hydro-Québec will seek to ensure that this potential can be achieved by intensifying technical and economic feasibility studies made jointly with customers.

- Maintain the dual-energy stock in the residential sector.

  Hydro-Québec will use two principal means to apply this strategy. It will offer participating customers a very attractive rate for off-peak consumption. This rate will allow customers to make substantial savings on their bills provided that they manage their consumption effectively and avoid using electricity during peak periods, when it will cost more. In addition, Hydro-Québec will offer customers after-sales service in collaboration with the oil companies, and it will partially defray the costs of this service. The new rate and after-sales service will be offered gradually, starting in the middle of 1987. First, customer installations will have to be checked and present meters replaced by double recording meters. In the next three years, Hydro-Québec will devote $50 million to this operation.

- Launch a new dual-energy program for the commercial, institutional and industrial sectors.

  A budget in the range of $40 million in grants will be devoted to implementing this strategy, which is intended to increase this market by 500 MW in 1987, 1988 and 1989. A new dual-energy rate, called BG, will be offered to this clientele.

- Test remote control as a method for load management.

  A pilot project involving outlays of $9.5 million has been underway since the fall of 1986 and will continue until 1988. The goal is to compare the efficiency of various kinds of equipment and measure the degree of acceptability of this method of load management with a sample of some 700 residential customers.

2. Increase the current industrial market by focusing on industries that are heavy users of energy and for whom electricity may constitute a major comparative advantage. In this way assist in the consolidation of existing industries or the introduction of new ones.

   This strategy is designed around risk and profit sharing formulas that are adapted to the special conditions of each customer.

3. Increase the share of electricity in the industrial market by focusing on electrotechnologies.

   The achievement of this objective implies the continuation of the program for introducing electrotechnologies and intensifying research.

Objective 3

Limit rate increases to close to those of anticipated inflation, while gradually reducing the cross-subsidization among customer categories and gradually adapting the rate structures to promote the development of profitable markets.

Strategies

1. Recommend for 1987 amendments to the Rate Bylaw according to the principles previously mentioned. This recommendation is detailed in a separate report entitled *Mémoire sur la tarification proposée pour 1987*. In the preparation of this Development Plan, average rate increases of 4.9%, 5.2% and 5.2%, effective May 1, were assumed for 1987, 1988, and 1989 respectively.

2. Define rate options that in addition to taking into consideration customer methods of operation, promote the use of electricity during off-peak periods and constitute attractive alternatives to standard rates.

Rates D, G, M and L are currently applied to most Québec customers. These rate structures will be gradually adjusted in order to better reflect the costs of supplying electricity. Parallel to this, rate options will be developed and gradually offered to various clienteles. Thus, in addition to current dual-energy B and BM rates, a residential dual-energy rate will be offered in 1987 and a new dual-energy commercial, institutional and industrial rate, called rate BG. In addition, the rate terms for customers who sign up for the interruptible power program will be diversified.

6. THE DEVELOPMENT OF EXTERNAL MARKETS

As part of the development of external markets, beyond disposing of surpluses, the company adopted in 1985 an orientation of achieving a lasting breakthrough in exports. This orientation was in response to the 1983 enlargement of Hydro-Québec's mission, which gave new latitude for exploring avenues for developing external markets, as long as they did not interfere with satisfying Québec's own needs.

However, development of these external markets must be approached from a different perspective than the Québec markets. On its Québec markets, Hydro-Québec faces demand it must satisfy at the lowest cost, with rate policies intended to gradually reduce the gap between the price of its various products and the cost of supplying them. For the external markets, on the other hand, Hydro-Québec has the choice of whether or not to undertake development. Moreover, the objective is to achieve a level of profitability that corresponds to what would be expected by shareholders in the private sector for projects of comparable risk, taking into account the additional costs of supply that are in fact incurred and the risks associated with such development.

6.1 Present Situation

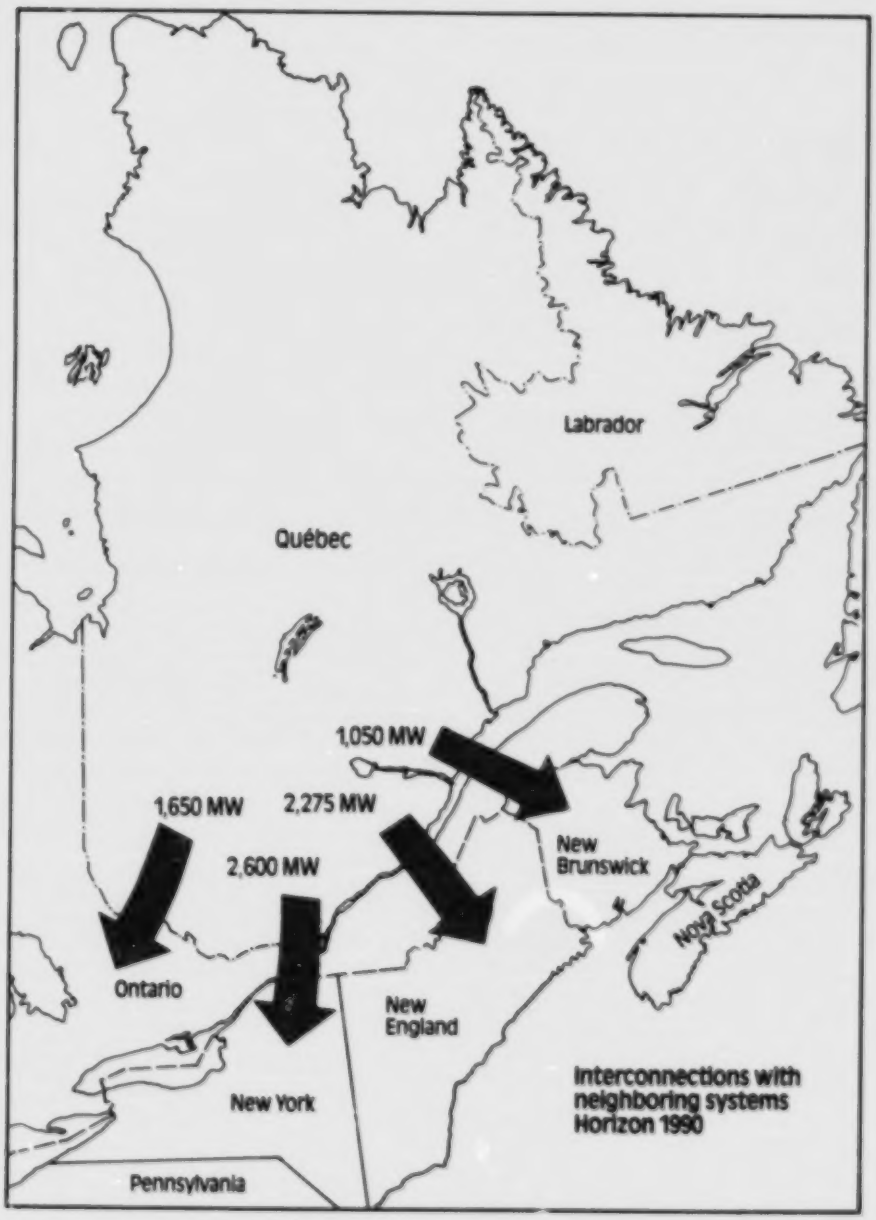
Québec's hydroelectric energy is an attractive source of supply for the electric utilities of neighboring regions. These companies depend largely on thermal generating stations, which have high production costs. At this time, Hydro-Québec is selling its surplus production to neighboring systems to replace some of the output of their coal and oil-fired power stations. Given growth in internal demand in Québec, this surplus will gradually shrink and be reabsorbed by the end of the century.

To continue development of external markets requires evaluation of the market in neighboring systems. There must also be an evaluation of the economic benefits of such sales, a review of the carrying capacities of existing interconnections and those under construction, and finally, a study of the possibilities available from new interconnections.

6.1.1 The Market in Neighboring Systems

At this time, demand in neighboring systems, the systems of New England and New York, as well as the Canadian systems in New Brunswick and Ontario, is mainly satisfied by the output of oil and coal-fired, nuclear and hydroelectric generating stations.

Map 1 - **Neighboring Systems**



The increase in demand for electricity in neighboring systems will be satisfied for some time yet by the addition of nuclear generating stations now being built and the increased use of existing oil-fired stations. These additions will accentuate present power surpluses. Nevertheless, the surpluses will gradually be reabsorbed by projected increase in load. Power and energy shortages will appear progressively by the end of the century, first for power and then for energy at an acceptable cost.

Given the operating costs of various existing sources of generation, Hydro-Québec's most likely possibility for the development of external markets involves filling these shortages of power and replacing oil-based generation. To fill some or all of their energy needs, the electric utilities of the neighboring systems may choose to import electricity from Hydro-Québec. They have other options available:

- intensification of conservation and load management measures;
- extending the useful life of existing generating stations and recommissioning of disused generating stations;
- increasing installed power of private producers and co-generation;
- building base-load coal or natural-gas power stations and even nuclear, combined-cycle or peak-load generating stations;
- importing electricity from other American power systems;
- importing from other Canadian power systems.

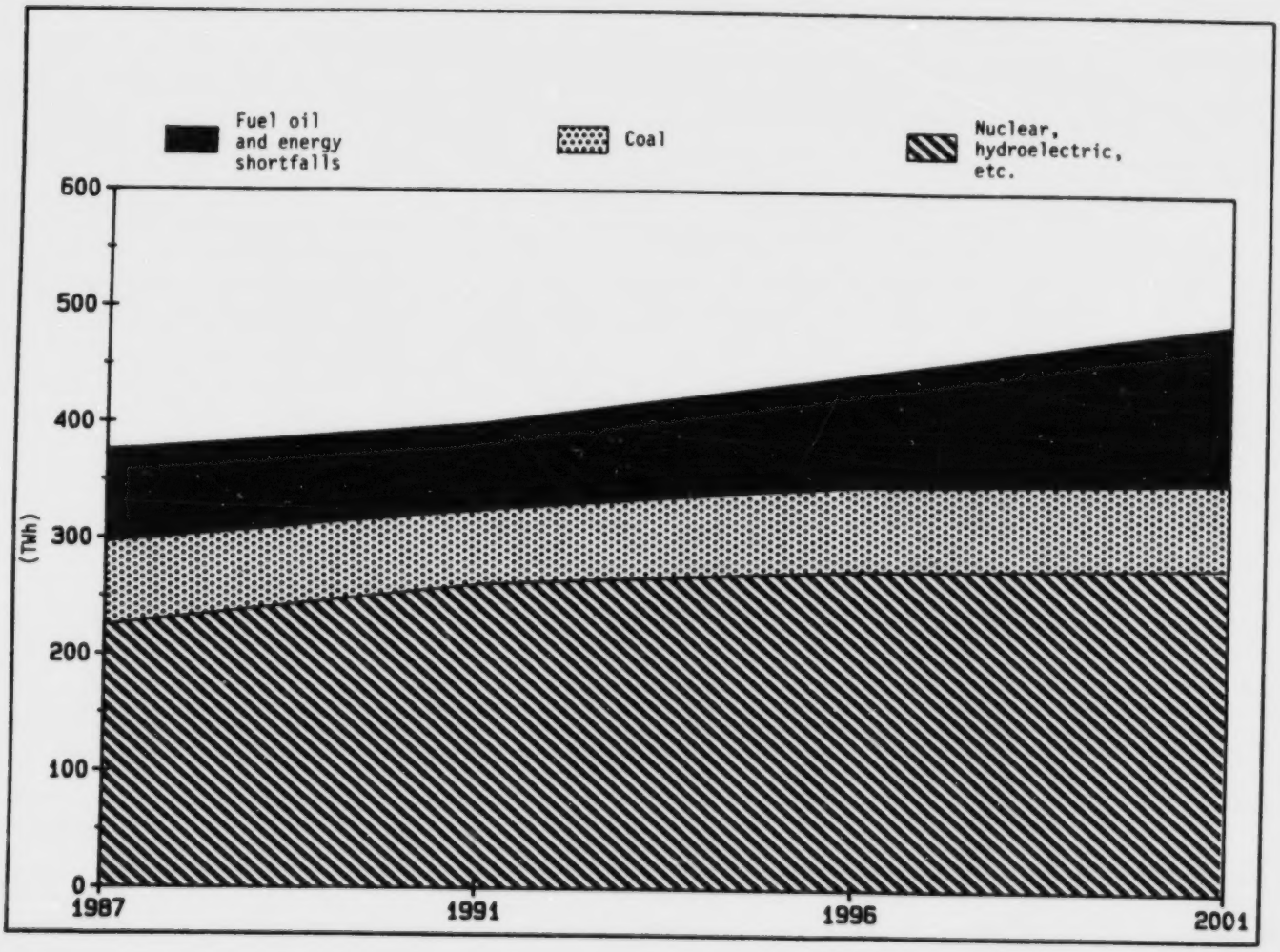
The Total Market

An evaluation of the total export market has been prepared, based on data from the most recent development plans published by various neighboring systems. The information generally covers the period from 1987 to 2001.

In their development plans, the neighboring systems have adopted a series of hypotheses involving the rate of growth of their internal demand, load management measures, co-generation and the construction of new generating stations.

In view of these assumptions, the total energy potential offered by filling energy shortfalls and replacing fuel oil is estimated at nearly 120 TWh in 2001.

Figure 15 **American and Canadian Neighboring Systems**
Total Output by Energy Source

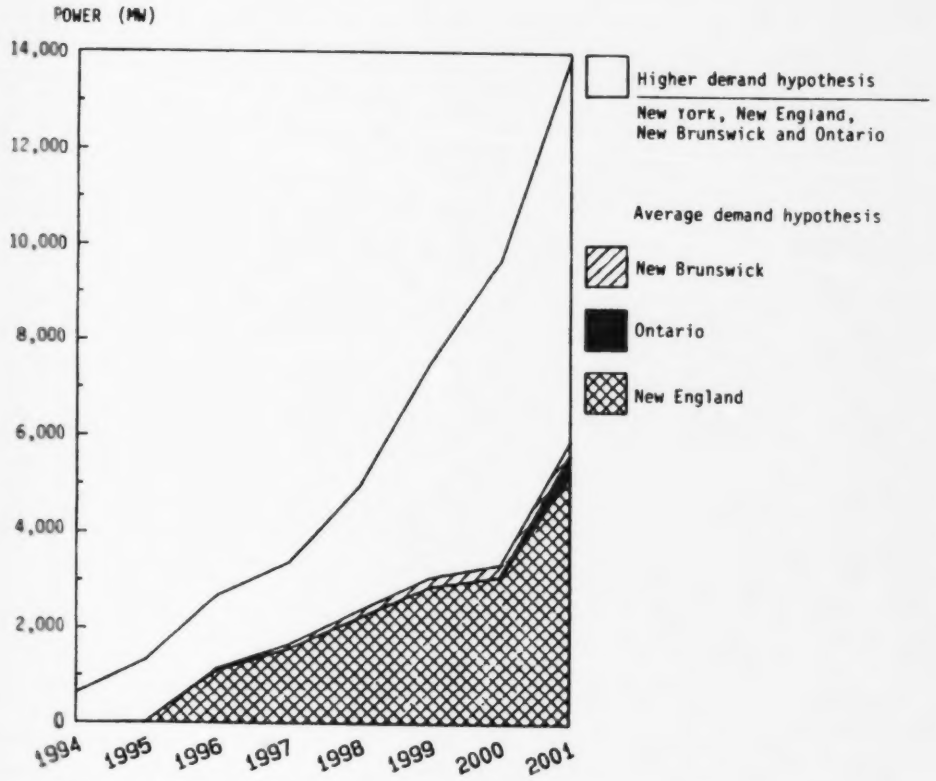


In power, the total potential includes shortages estimated at 5,900 MW in the 2001 horizon. These will appear gradually, starting in 1996 and can be broken down into 5,200 MW for the American systems and about 700 MW for the Canadian power systems of Ontario and New Brunswick. In the 2001 horizon, the power deficits on the American systems will come mainly from the New England states. The power deficits in New York State will appear after 2001. Beyond this horizon, power deficits rise sharply but no short-term decision is required with regard to them.

These shortfalls assume that the load management programs and development of major co-generating capacity on the part of independent producers is extremely successful. They also assume that the program to extend the lifespan of existing oil and coal fired power stations is carried out and the new nuclear generating stations now being built are in fact commissioned.

If the load growth assumptions used by the neighboring systems in their development plans should be revised upward by one-half a percentage point, the 5,900 MW market might reach nearly 13,900 MW in the 2001 horizon. Using this assumption, the power shortfalls would be 7,500 MW for the New England states, 2,800 MW for New York State, and 3,600 for the Canadian systems in Ontario and New Brunswick.

Figure 16 **American and Canadian Neighboring Systems**
Power Shortfalls



Source: Estimates based on 1986 development plans from neighboring systems.

Market for Sales of Firm Power and Energy

To satisfy power shortfalls that will appear in the 2001 horizon, a number of options are available to the neighboring systems. Given the general uncertainty about fuel prices and the future of the electricity market, the American systems are more likely to adopt solutions requiring less investment. Nevertheless, some of these power and energy shortages are likely to be satisfied by new base-load generating stations.

Importing electricity from the Hydro-Québec system is an attractive solution for the neighboring systems to the extent it offers the same security of supply as base-load systems while not requiring such large investments. Hydro-Québec has conducted negotiations through the year with the neighboring systems for the sale of firm power and energy.

To that end, a letter of intent was signed in February 1987 which, by the end of the year, should lead to the conclusion of a contract with Central Maine Power Compagny for the sale of blocks of firm power and energy, starting with 400 MW in 1992 and reaching 600 MW in 1995, 900 MW in the year 2000, and later declining progressively before the contract expires in 2020.

Oil-fired Generation Substitution Market

Even with the construction of new generating stations, a major portion of the output of neighboring systems would continue to depend on existing oil-fired generating stations. This would continue until the year 2001, especially since in the current context of lower oil prices, major efforts will be made to extend the life of existing oil-fired stations. Beyond this horizon, consumption of oil would gradually diminish. This downward trend can be explained by the gradual dismantling of obsolete oil-fired stations and the addition of base-load stations to take the place of some of the output of existing oil-fired stations.

The replacement of the output of oil-fired generating stations during the 1986-2001 period therefore constitutes a major market. It should be noted that compared to last year, the potential for replacing oil has increased, due to the dropping of coal-conversion projects, the extension of the life of oil-fired generating stations and the low projections of coal-fired generation stations to be added in the 2001 horizon. In this horizon, oil-fired generation will be on the order of 105 TWh.

However, a portion of the needs for fuel oil cannot be replaced, given the requirements and operating constraints of electrical power systems. These include the necessity of maintaining a minimum of generation locally, either to ensure the rapid restoration of load or to maintain the electrical voltage or to produce steam for industrial purposes. Furthermore, since generation from this remaining oil is to a large extent concentrated in the daytime, and in some cases a relatively small number of hours each year, it could not be totally replaced by base-load hydroelectric equipment working all year round.

6.1.2 Economic Advantage of Québec's Hydroelectric Generation Compared to the Generation of the Neighboring Systems

Comparison of the costs of commissioning and operating new base-load generating stations in the United States, whether coal-fired or even the installation of peak-load equipment associated with increased oil-fired output, and new nuclear generating stations in Canada with the costs of the first hydroelectric projects to come from Québec, reveals an attractive profit margin for Hydro-Québec and its customers in the case of firm power and energy sales. Nevertheless, this profit margin becomes smaller as increasingly more expensive projects in Québec are considered.

The profitability of sales on the energy replacement market generated from existing oil-fired stations is a function of the price of oil and appears uncertain in the current context of oil price fluctuations. As a result, the sale of firm power and energy would allow a lasting breakthrough on external markets. With respect to replacing oil-based generation, this market would depend on the future price of oil.

6.1.3 Capacity of Interconnections with Neighboring Systems

At the end of 1986, interconnection capacity was 5,415 MW. In 1986, Hydro-Québec commissioned additional capacity of 690 MW to New England, rising to 2,000 MW in 1990. Interconnection capacity will reach 6,675 MW in 1990.

Table 11 - **Interconnection Capacity between Hydro-Québec and Neighboring Systems (In MW)**

Neighboring systems	Horizon 1990
Canada	
- New Brunswick	1,050
- Ontario	750*
	1,800
United States	
- New England	2,275
- New York	2,600*
	4,875
Total	6,675
* The interconnection capacity with Ontario is 1,650 MW and can be used to its maximum by reducing the exports to New York State by 900 MW.	

If these interconnections could be used at full capacity throughout the year, it would be possible to export up to 55 TWh/year. In actual practice, because of forced outages and maintenance, the carrying capacity available is only 49 TWh/year, of which 38 TWh/year goes to the United

Moreover, the availability of this carrying capacity is still conditional on the solution of certain technical problems. These appeared at the commissioning of the last interconnections with the United States and are the subject of a number of major joint studies between Hydro-Québec and the neighboring systems.

Beyond technical considerations of reliability, there are certain bottlenecks on the American power systems. These bottlenecks restrict access to major consumption centres, preventing the use of the existing interconnections at their maximum. Full utilization of the interconnections will be possible when transmission capacity constraints on the American power systems are resolved. Thus, full use of the transmission capacity with New York Power Authority (NYPA) should become possible in 1988, with the Marcy South Project adding lines in New York State. Likewise, the increase of the interconnection with NEPOOL to 2,000 MW will require the construction of a direct-current line from Comerford, New Hampshire to Sandy Pond, in the Boston area.

6.1.4 Problems of Adding New Interconnections

The nature of the problems changes with the scope of the interconnections considered. For nearby, easily accessible markets, Hydro-Québec can develop additional interconnections averaging from 500 to 1,000 MW. Beyond such additions, the company would have to develop large-scale interconnections intended for the sale of firm power and energy farther south. These additional transmission facilities could be largely needed in densely inhabited zones and as a result, be subject to longer construction periods, in view of the number of parties involved and interests they represent.

Whatever the scale of the additions, the company will evaluate their impact in terms of the regional features and activities competing with energy transmission. The strategy on the development of the Hydro-Québec transmission system is discussed in Chapter 7 in greater detail.

6.1.5 The Prospects of Three-Stage Development

The existence of a substantial profitable export market for Québec's electricity suggests the extension of the first stage of export market development currently underway to a second and third stage of development. Although these imply deliveries at different periods, each requires major efforts now, varying in terms of what each of them involves.

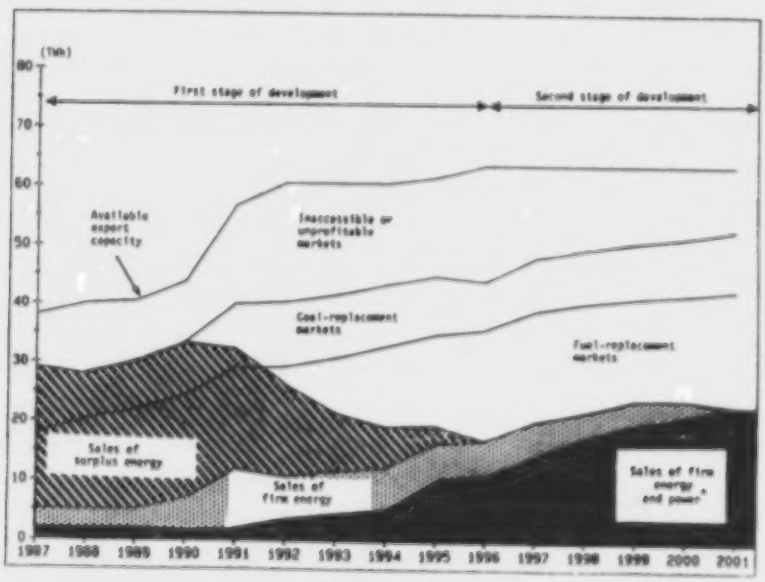
First Stage of Export Development

As part of the first stage of development, the last three years were marked by major efforts by the company to expand its export sales and thus dispose of its surpluses. The increase in interconnection capacity and intensification of their use made it possible to support such an effort. The company commissioned an additional 1000-MW link with New York State in 1984, followed in 1985 by additional links with New Brunswick (350 MW) and Vermont (200 MW) and in 1986, a 690-MW link with NEPOOL. This allowed a nearly 50% increase in export sales, rising from nearly 20 TWh in 1983 to about 30 TWh in 1987.

From 1987 to 1995, Hydro-Québec expects still to have energy surpluses, which will be sold on accessible surplus energy markets, using existing and planned interconnections. Nevertheless, starting in 1991, the surplus energy sales will begin to shrink gradually as the surplus declines. This will result in a reduction of sales on the least lucrative market, the replacement of coal-fired generation. This market should be completely abandoned by 1992. Later, the oil-fired generation replacement market will be gradually abandoned. Sales on this market should continue until 1995, however.

During this first stage of export development, the company is seeking to maximize revenues achieved from selling its surpluses. At this time, most of the export revenues come from transactions in which buyers and sellers agree on deliveries on a daily basis. This situation is likely to cause fluctuations in export revenues. The company may reduce this risk by selling blocks of firm energy, as has been the case for the firm energy contract with NEPOOL.

Figure 17 - **Use of Interconnections**
Export sales of electricity (in TWh)



* 3,500 MW hypothesis

Second Stage of Export Development

The second stage of development is based on the optimum use of existing and planned interconnections and the addition of medium interconnections to outlying regions. In this context, the company is planning a sales objective for firm power and energy to the neighboring systems between now and the year 2000 of up to 3,500 MW, for an average length of 15 years. In fact, this option proves to be the most profitable for achieving a lasting breakthrough on export markets. Under favorable conditions, this quantity might rise to 4,500 MW.

In any case, the company must have available on the interconnections sufficient margins to dispose of occasional generating surpluses, due to such factors as heavy run-off or temporarily reduced internal demand in Québec, and to satisfy mutual assistance requests between Hydro-Québec and the neighboring systems.

With respect to economics, the second stage of export development offers the parties a sufficient profit margin to absorb the risks that are likely to affect such a project. Some of these sales should be agreed to within the next two or three years, given the delays that the neighboring systems allow themselves before reaching a decision on the filling of the power and energy shortage that will become apparent from 1996.

The previous figure shows an example of the use of interconnections after 1996 as part of the second stage of development.

Third Stage of Export Development

The export prospects included in the third stage are substantial. Power deficits are likely to increase sharply after 2001, and the neighboring systems, instead of building new generating stations, may sign long-term import agreements with Hydro-Québec.

The third stage will probably require the development of additional interconnections that will be substantial in length and present special technical and environmental constraints. The company will continue its studies with neighboring systems to develop solutions to the technical constraints and ensure the environmental feasibility of energy deliveries. Likewise, the rescheduling of large-scale hydroelectric projects will require large amounts of borrowing and the company will continue studies intended to clarify the feasibility of innovative forms of financing to promote risk-sharing adapted to such projects.

The company will also undertake discussions with neighboring systems and intensify its promotional activities with all parties involved, both Canadian and American.

6.2 Objectives and Strategies

Objective 1

Maximize revenues associated with the sales of existing surpluses.

Annual load growth in neighboring systems will progressively lead some systems to depend on oil, at least until the end of the century. At the same time, the company expects to have surpluses. These surpluses will be sold on the surplus energy market. Hydro-Québec could then guarantee part of its sales, for protection against the unpredictable nature of surplus energy sales.

Strategies

1. Increase the value of marketable products from surpluses, either as firm annual deliveries or energy available at critical times for the neighboring systems.

2. Gradually adjust the price policy to reflect market changes.

Objective 2

Consolidate the breakthrough on export markets by commitments for sales of firm power and energy to neighboring systems by the year 2000 between 3,500 and 4,500 MW.

This development objective is mainly intended to benefit from existing or planned interconnections and the possibility of adding smaller interconnections for firm power and energy contracts that would allow neighboring systems to meet the demand that will gradually become apparent in 1995 and will require decisions from them in the next two or three years.

Strategies

1. Pursue negotiations with various neighboring systems concerning proposals on long-term sales of firm power and energy.

   Hydro-Québec's proposals involve a price formula that reflects the total costs of generating stations that neighboring systems would have to build. In some cases, these offers include delivery reduction clauses in case of low run-off conditions and financial participation.

2. Develop small and medium-size interconnections, reflecting environmental requirements.

   The identification of corridors satisfying the possibilities of the company's transmission system and environmental protection and development objectives in Québec allows preference to be given in negotiating energy sales to connection points to the neighboring systems that are optimally adjusted to the technical and economic constraints of the company and the environmental necessities.

3. Pursue studies and implementation of measures likely to optimize the use of existing interconnections.

Objective 3

Pursue steps seeking sales of firm power and energy to neighboring systems beyond the quantities planned in the second stage of development.

   This development stage offers substantial, promising sales potential for Hydro-Québec. In view of what is at stake, the company ought to identify and resolve the problems that can already be perceived.

Strategies

1. Establish price formulas, terms of sale and various contract provisions in order to develop the export market associated with this development stage even more.

2. Verify the feasibility of innovative financing methods that are adapted to large export projects.

3. Ensure the technical, economic and environmental reliability of the delivery of major additional quantities of electricity to the major consumption centres of neighboring systems.

4. Pursue discussions with neighboring systems for the sale of firm power and energy above 3,500 MW.

5. Pursue promotional efforts with various agencies, both American and Canadian.

7. OPERATION OF INSTALLATIONS

With the approaching end of the period of surpluses, Hydro-Québec must seek to improve the output of its existing generating plant. Likewise, substantial improvements will be made in the transmission, sub-transmission and distribution systems, in order to enhance the quality of service on Québec and external markets.

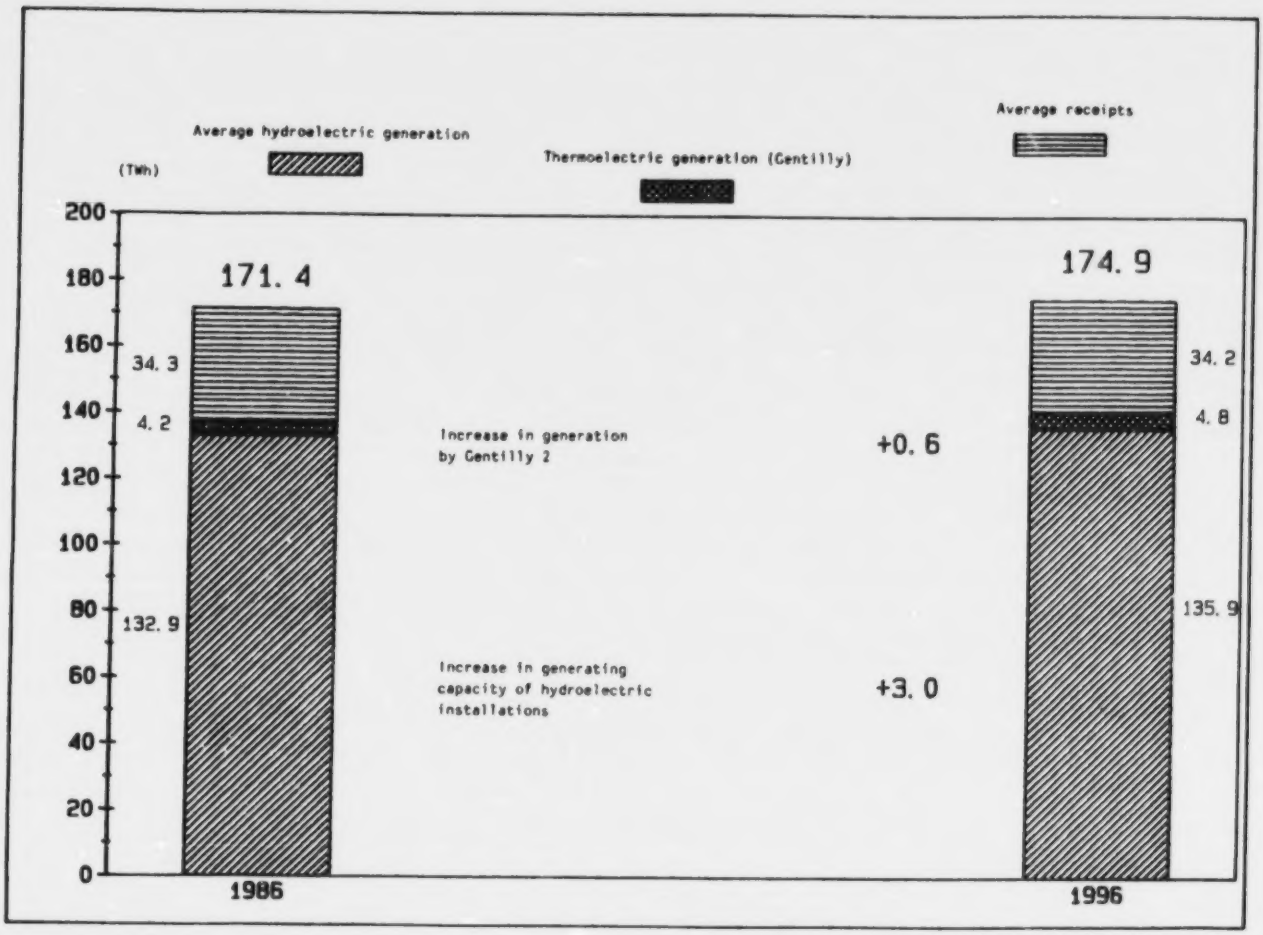
7.1 Existing Plant and Improvements

7.1.1 Energy and Power Supply

The average energy output of Hydro-Québec's hydroelectric installations was 132.9 TWh in 1986 given the commissionings of the last units of the LG 4 generating station, which complete the execution of Phase I of the La Grande complex. Added to this hydroelectric production is the output of Hydro-Québec's thermal generating stations, especially Gentilly 2 nuclear power station, about 4.2 TWh, and electricity purchases of 34.3 TWh per year, mainly from Churchill Falls, bringing the average energy supply of the company in 1986 to 171.4 TWh/year.

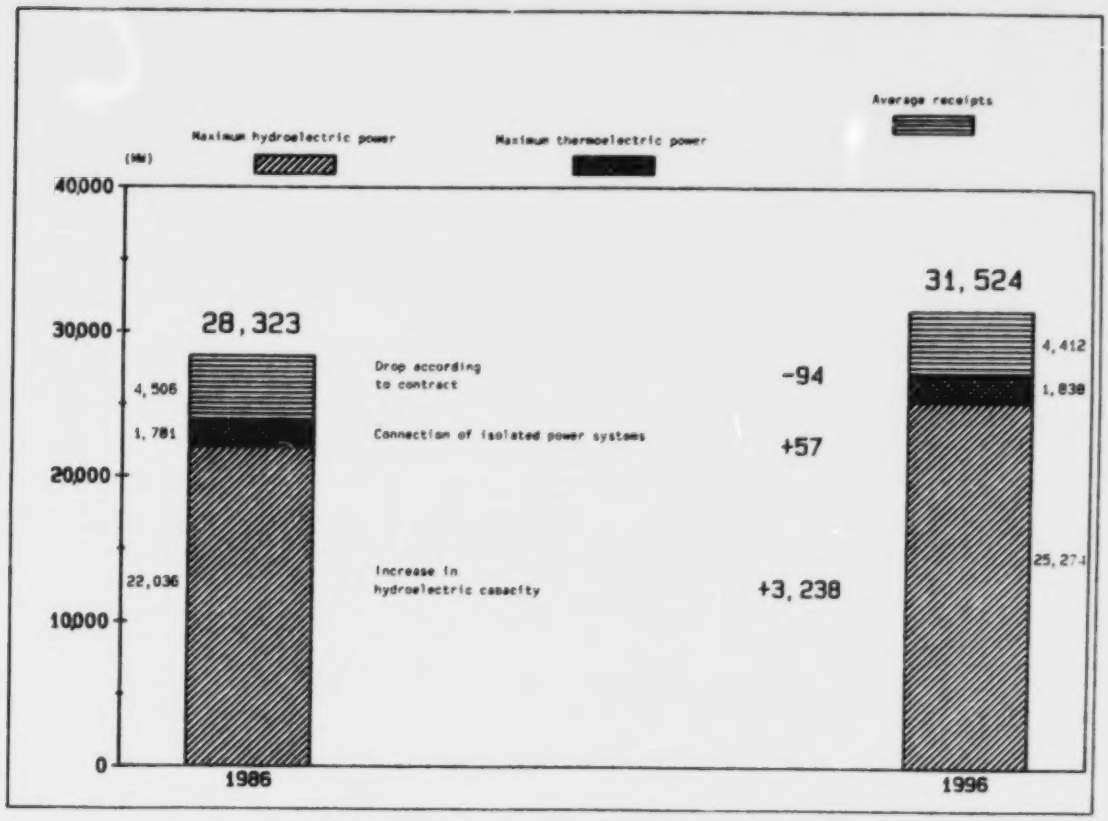
Hydro-Québec expects to commission additional capacity at Manic 5 AC in 1989 and LG 2 A in 1992-93. At the same time, various supply management measures will be proposed to increase the output of the hydroelectric installations. Such measures include the renovation of structures now in operation and the increased automation of the management of hydroelectric generating stations. By 1996, these two measures combined with increased output from Gentilly 2 and the commissioning of LG 2 A will bring average energy supply to 174.9 TWh per year, an increase of about 3.5 TWh.

Figure 18 - **Energy Supply from Existing Facilities and Improvements by 1996**



In view mainly of the commissioning of additional capacity at Manic 5 P A (980 MW) in 1989 and LG 2 A (1,900 MW) in 1992-93, and the renovation of structures currently in operation, the maximum power available will rise from 28,323 MW in 1986 to nearly 31,524 MW in 1996.

Figure 19 - **Power Supply from Existing Facilities and Improvements by 1996**



7.1.2 Reliability and Means for Ensuring It

Energy Reliability

Hydroelectric output is dependent on run-off levels. These fluctuate from season to season, are low in summer and high during the spring and fall floods. They also vary from year to year. To provide output that corresponds to demand and its profile, hydroelectric installations must be able to accumulate inflow at certain periods and make use of it at others. Two types of energy reserves are therefore distinguished: inter-seasonal reserves, which make it possible to fill in the gap between the annual cycle of demand and inflows each year, and the multi-annual reserve, which helps satisfy demand in the case of several successive years of low inflow and to accumulate water during years of high run-off.

The company has a number of ways of satisfying these reserve requirements: reservoirs, the use of Tracy thermal generating station and various other methods, such as purchases of support from neighboring systems, the recall of a portion of export sales and, in exceptional circumstances, greater withdrawals from its reservoirs.

Power Reliability

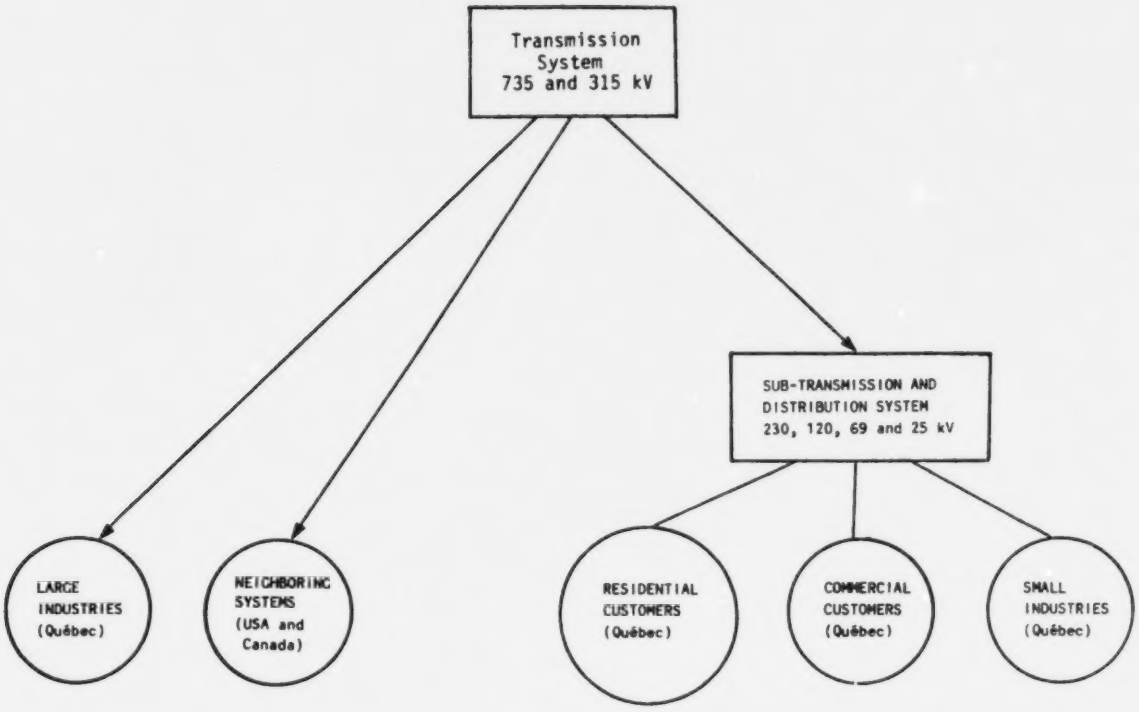
The generating plant must also be able to satisfy electricity demand at the most critical time of the year, which is the annual peak load of the system, and this must reflect the potential unavailability of some equipment. The company must therefore have available a supply of power that is greater than demand. This is the reserve necessary to ensure power reliability.

The company has a number of means for satisfying these needs, including generating equipment, but also such possibilities as buying power from neighboring systems as part of reserve sharing agreements and the interruption of interruptible loads to industrial customers who have signed up for the interruptible power program described in Chapter 5.

7.2 The Transmission, Sub-transmission and Distribution System and Improvement of Quality of Service

Electricity is sent to residential and commercial customers and to small industries through the transmission, sub-transmission and distribution systems. Major industries and the neighboring systems are supplied directly from the transmission system and therefore at a higher voltage level than other Québec customers.

Figure 20 - **The Transmission, Sub-transmission and Distribution system**


Transmission System 735 and 315 kV
SUB-TRANSMISSION AND DISTRIBUTION SYSTEM 230, 120, 69 and 25 kV
LARGE INDUSTRIES (Québec)
NEIGHBORING SYSTEMS (USA and Canada)
RESIDENTIAL CUSTOMERS (Québec)
COMMERCIAL CUSTOMERS (Québec)
SMALL INDUSTRIES (Québec)

Quality of service may be affected, either by infrequent incidents that have a very great impact, or the cumulative effect of incidents with low impact but high frequency. The transmission system is mainly affected by the first category of incidents, The Hydro-Québec transmission system, which supplies all customers, inside and outside Québec, causes widespread problems when it fails. It is this extension of impacts that must be minimized if quality of service is to be improved.

Failure on the sub-transmission and distribution system produce local outages. It is the frequency of these service interruptions that should be reduced.

7.2.1 Transmission System

Because of its structure, Hydro-Québec's transmission system is particularly vulnerable to certain disturbances that could lead to chain reactions in protection systems and result in a general power failure.

During the 1969-1979 period, the transmission system experienced a large number of failures, including eight general failures. Since then, performance has substantially improved. The transmission system, which was installed between 1965 and 1970, represented an experiment with a new very high voltage transmission technology. Subsequent years allowed better mastery of the design and operation of this technology and improvement in the performance of the system. Moreover, the extension of the transmission system as part of the James Bay project resulted in strengthening the overall structure of the system. Nevertheless, although a substantial improvement was observed beginning in 1979, there must be continued improvement in performance for the benefit of the company's Québec and external clientele.

Because of its size, duration and surprise effect, a general power failure means substantial direct and indirect costs, not to mention many other inconveniences for Hydro-Québec's customers. For Québec markets, improvement of the transmission network would reduce economic losses caused by these outages. For external markets, the impact of a general power failure in Hydro-Québec could be very serious. The sudden loss of a major source of power can destabilize the neighboring system and cause major failures on their systems. Because of the thermal nature of the generating plant in the neighboring systems, their restoration of service is much slower. This substantially amplifies the impact of these failures on the clientele of these systems.

In order to avoid the consequences of a general power failure at Hydro-Québec, exports using direct-current ties must now be limited to 2,200 MW. Beyond such power levels, any export must be made radially, from an isolated source of supply.

The improvement of the transmission system would eliminate these constraints and allow all exports to be made from the Hydro-Québec main system. This solution would also make it possible to develop export markets by earlier construction of generating and transmission facilities required in the longer term by Hydro-Québec, rather than selecting sites for development in terms of their accessibility for serving export markets. Furthermore, it would allow flexibility in supplying neighboring systems, independent of the selected points of supply or starting date of export contracts.

The company therefore expects to have neighboring systems accept new design criteria for the transmission system, which would reduce the risk of general power failures to cases of extreme contingencies. Nearly $600 million will be spent between 1988 and 1991 to implement these new criteria.

7.2.2 The Sub-transmission and Distribution System

The sub-transmission system, which supplies 2,800,000 customers, is the most vulnerable because of its extent (96,500 kilometers of line, 91,500 overhead and 5,000 underground) and the large number of components it contains.

Of the total duration of outages experienced by customers supplied from the sub-transmission system, 70% are due to sub-transmission system and 30% to the transmission and distribution systems. Of all sub-transmission system outages, 50% are planned to allow work on the lines and 50% are due to failures.

The implementation of the Occupational Health and Safety Act has contributed to increasing the number of planned outages. Workers exercise their right to refuse work under abnormal conditions. The stress must therefore be put on the safety of the work environment, and this means improvement in the organization of work, the engineering of the system and the training of workers.

A major program with total funding of $1 billion dollars, $400 million of which is for the sub-transmission system, has been in effect since 1984, to improve continuity of service throughout the territory. It is designed to make improvements at all levels where strengthening is necessary. At the end of 1986, the company had completed work covering half the total budget; 60% of the budget has been invested in the sub-transmission system.

As part of the regular investment program, organized maintenance and action programs must be prepared to prevent failures and increase the rapidity of service restoration following customer requests. Likewise, studies of new system configurations will be made to increase the flexibility and maneuverability of the system.

7.3 Supply and Demand Balances

7.3.1 Target Demand, with the Québec and Export Market Development Strategies

The strategies for developing Québec and export markets modify the reference demand presented in Chapter 4. The load in its new form is the target load used for planning.

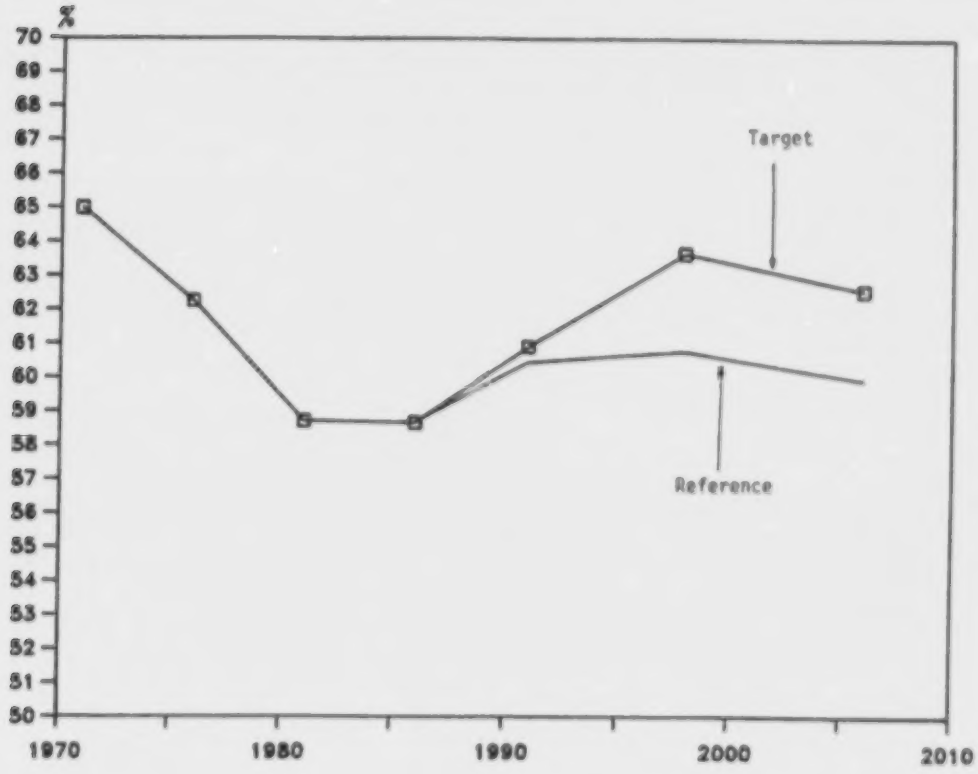
The strategies on Québec markets with respect to residential dual-energy adaptation of rates and intensification of the interruptible power program should substantially reduce peak power demand, with relatively slight impact on overall energy demand.

Table 12 - **Impact of Québec Market Development Strategies on Priority Needs**

Impact	1986	1991	1996	2001	2006
Peak-Load Power (MW)	-20	-1,000	-2,390	-2,540	-2,620
on which:					
- Dual-energy and rate policy	-20	-650	-890	-1,040	-1,120
- Additional interruptible*		-350	-1,500	-1,500	-1,500
Energy (TWh)	0.0	-0.7	-0.7	0.2	0.4
*In addition to the present 500 MW.					

Such strategies will increase the load factor for system priority needs, as the following figure indicates:

Figure 21 - **Load Factor for Hydro-Québec Priority Needs**
After shedding interruptible loads



The external market development strategy, focused on selling 3,500 MW of firm power and 23 TWh of firm energy per year in the 2000 horizon, will increase export sales of firm electricity.

The following table indicates firm needs for all electricity on markets to be satisfied in the target demand scenario.

Table 13 - **Firm Needs in the Target Demand Scenario (TWh)**

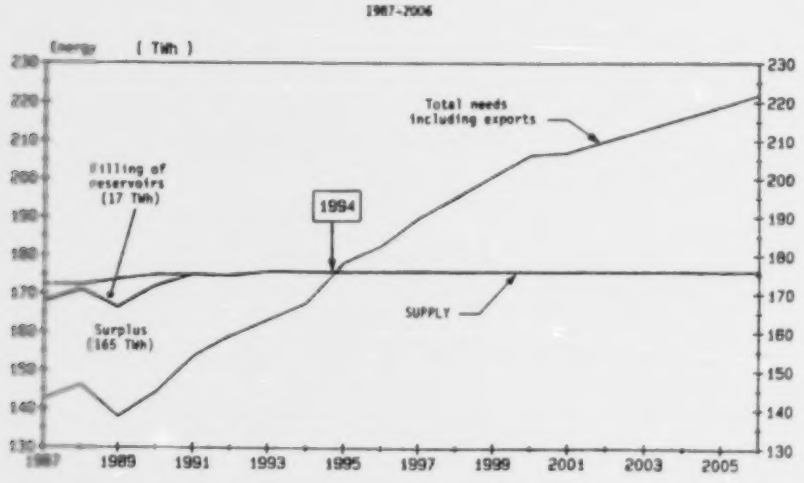
	1987	1988	1989	1990	1991	1996	2001	2006
Sales of firm electricity in Québec	109.9	112.9	116.3	120.0	124.0	145.2	161.9	175.4
Sales of surplus electricity in Québec*	13.3	13.3	1.8	-	-	-	-	-
Deliveries as per agreement in Québec	3.3	3.3	4.0	4.0	4.0	4.0	3.5	3.5
Sales of firm electricity for export	5.1	5.1	5.0	6.8	11.9	16.9	23.0	23.0
Electrical losses associated with all sales	12.8	13.2	12.9	13.3	14.1	16.6	18.7	20.1
Firm needs to satisfy	144.4	147.8	140.0	144.1	154.0	182.7	207.1	222.0

* Most of these sales are guaranteed.

7.3.2 Balance between Supply and Target Demand: Existing Plant and Its Improvements, to Satisfy Target Demand until 1994

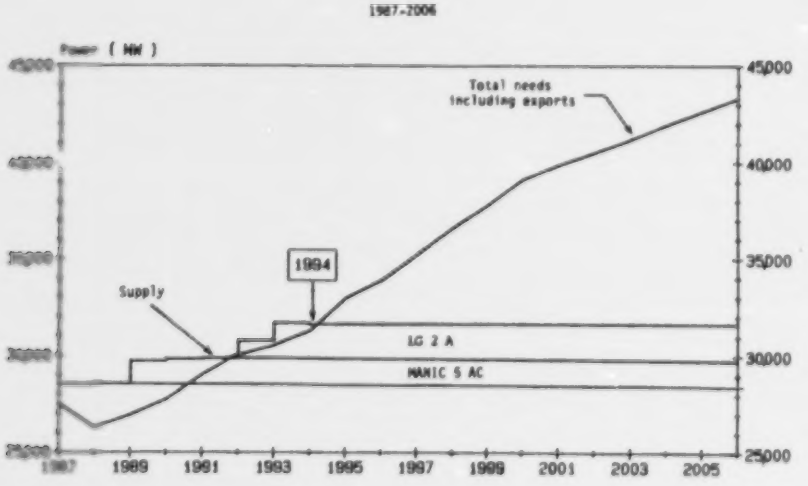
Average energy supply of the company, estimated at 171.4 TWh per year in 1986, given the improvements to the generating facilities, is adequate to satisfy Hydro-Québec's contract commitments until 1994, as is indicated by Figure 22. In this context, no new base-load installation is required before 1995. Until then, Hydro-Québec will have energy surpluses totalling about 165 TWh. Because of the electrical losses associated with the transmission system, estimated at nearly 9 TWh, these surpluses will result in sales of about 156 TWh on the surplus electricity markets.

Figure 22 - Target Demand for Energy with Respect to Supply



For power, the supply from existing installations and their improvements, combined with the additional capacity from Manic 5 AC in 1989 and LG 2 A in 1992-93, is adequate for the needs to be satisfied until 1994, as can be seen on Figure 23. The company needs no additional new peak-load equipment before 1995.

Figure 23 - Target Demand for Power with Respect to Supply



7.4 Objectives and Strategies

Objective 1

Reduce the number and duration of service interruptions by enhancing the reliability of all systems serving clientele, to improve quality of service.

Strategies

1. Complete by the end of 1988 the program intended to restore the level of quality of service for all clientele by improving the sub-transmission, distribution and transmission systems. This represents investments of $985.8 million; at the end of 1986, $498 million had already been invested.

2. Establish a program to improve quality of service per customer category. To do this, the company will establish a standard of electricity supply quality per customer category, define protection and switching criteria, and ensure greater consistency between design operation and maintenance criteria for generating, transmission, sub-transmission and distribution equipment.

3. Improve the architecture and design of certain elements of the underground distribution system, in order to increase its reliability and review the ergonomics of installations in terms of the safety of workers.

4. Have accepted by the neighboring systems the new design criteria for the transmission system and introduce these new criteria from 1988 to 1991. This will represent investments of $600 million.

Objective 2

Continue the program to renovate, refurbish and modernize installations and reduce the environmental risks associated with their operation.

As part of these activities, the company will harmonize its activities with the needs of other parties involved in Hydro-Québec projects.

Strategies

1. Continue the special generating station refurbishing program at Shawinigan and Grand-Mère, Bersimis 1 and 2 and execute studies to be able to decide whether to modernize Les Cèdres, Chelsea and Rapides Farmers generating stations. At the Daniel Johnson Dam, studies of alternatives are continuing and should result in the selection of a solution in 1987. So far, the company has invested nearly $114 million in refurbishing generating stations. During the 1987-1996 period, it plans to invest nearly $3.2 billion more.

2. For the isolated power systems, in addition to programs intended to allow customers to satisfy their overall energy needs at an acceptable cost adapted to their local conditions, Hydro-Québec is considering alternative solutions to the existing diesel generating units, such as an underwater link to the Magdalen Islands.

3. Managing environmental risks linked to the operation of installations. In particular, the company will continue to study and manage the risks associated with mercury release in reservoirs, the biological effects of electrical and magnetic fields from transmission lines and the use, transport, storage and disposal of polychlorinated biphenyls (PCBs). Likewise, the company will continue its program for reducing the impact of and developing its installations and properties.

Objective 3

Increase the production capacity of existing plant and optimize the exploitation of energy resources, including taking maximum advantage of the possibilities of exchanges with the neighboring systems.

Strategies

1. Equip the system operations centres with automatic control devices and software and continue the operating staff training program in order to improve the performance of the generating stations; by 1990, some $1.4 million will have been invested in these activities.

2. Introduce in 1987 a study program to improve the operation of the system, involving mainly the possibilities of exchanges with neighboring systems, greater withdrawals from reservoirs and the more efficient use of total energy reserves necessary to guarantee electricity supply.

Objective 4

Pursue automation of systems and maintenance procedures.

Strategies

1. Improve the efficiency of system operation by modernizing the distribution operating centres. Accelerate the implementation of one aspect of the distribution operating centres, the temporary outage management system, which will speed up locating outages and informing customer services.

2. Continue the execution of pilot projects begun in 1986 for the remote control of strategic switching points on the system.

3. Invest in research and development of automated tools (remote handling and robots) to improve the quality of service and safety of workers and the modernization of the computer tools needed to execute activities such as planning and engineering. The company plans to invest nearly $25 million in this area from 1987 to 1989.

8. DEVELOPMENT OF INSTALLATIONS

The development of installations is intended to satisfy shortfalls that are expected to appear starting in 1995. To ensure its future development, Hydro-Québec has substantial undeveloped potential available.

8.1 Undeveloped Hydroelectric Potential

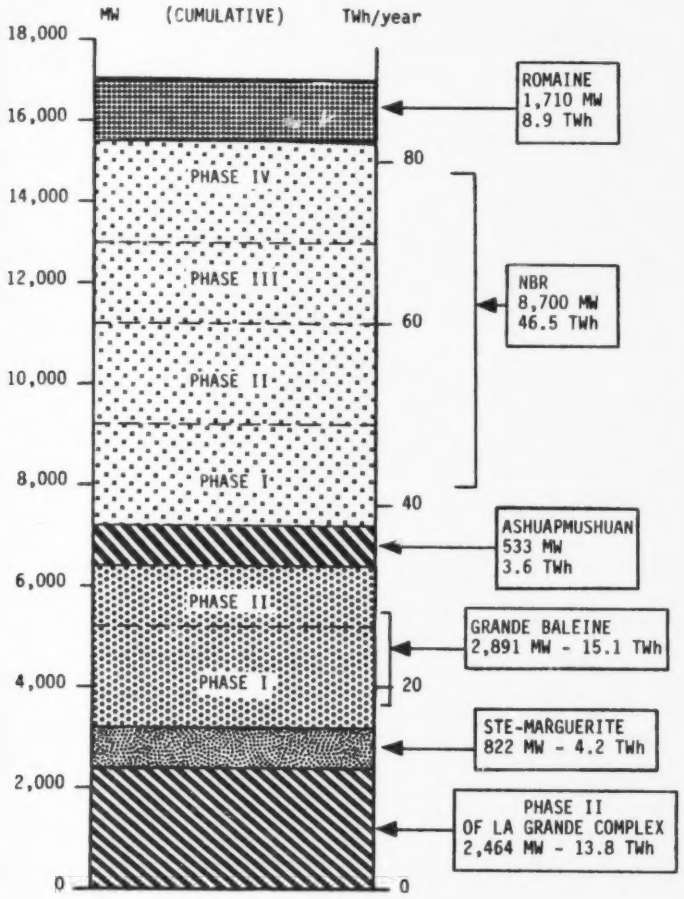
Large, as-yet undeveloped rivers offer an energy generating capacity of the order of 200 TWh/year. The corresponding installed power capacity would depend on the annual delivery profile. For example, if this energy is to be produced at an 80% utilization factor, the potential would be equivalent to 30,000 MW. The development of small rivers would represent a further potential of the order of 10,000 MW.

Map 2 - **Undeveloped Hydroelectric Potential**
Geographic Location

If the potential of the large rivers were delivered at a utilization factor of 60%, however, or substantially the system load factor, this potential would be equivalent to nearly 38,000 MW. According to studies now available, a portion of this potential, some 90 TWh per year, totalling 11,000 MW at a utilization factor of 60%, would be more economical than any other electricity generating option. This includes nuclear generating stations as well as oil or coal-fired.

The 90 TWh potential comes from the following projects: La Grande - Phase II (LG 1, Laforge 1 and Brisay), Sainte-Marguerite, the Grande Baleine complex, Ashuapmushuan, the Nottaway-Broadback-Rupert (NBR) complex and the La Romaine complex. These projects are listed in order of increasing cost.

Figure 24 - Ranking of Projects by Increasing Cost

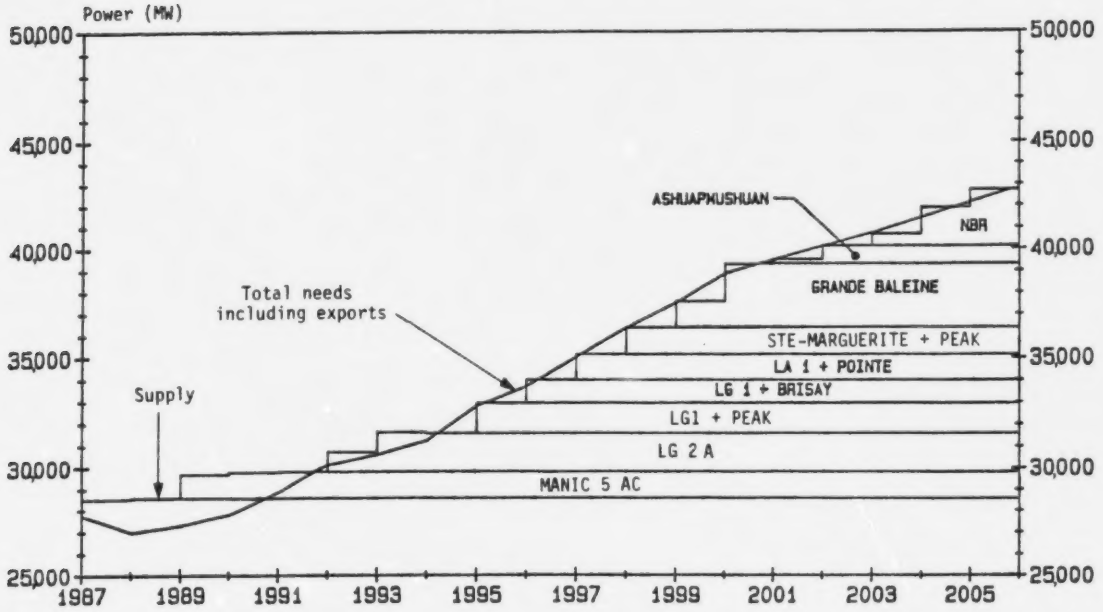


8.2 The Target Construction Program

8.2.1 Commissioning Dates

Chapter 7 showed that power and energy shortfalls would appear in 1995. The following figure shows the construction program required to fill these shortfalls. The program is based on a ranking of projects in order of increasing cost, made possible by the transmission system improvement strategy described in the previous chapter. This strategy would allow the exports planned in the target scenario to be made on the main Hydro-Québec transmission system. If such a transmission system improvement strategy is not implemented, there could be modifications in the order of commissioning and therefore a more expensive construction program.

Figure 25 - **Target Construction Program**
Supply and Demand Management and 3,500 MW Exports
1987-89 Plan, Horizon 1996



The following figure points out the rescheduling of base-load equipment required by export sales of firm power and energy of 3,500 MW. In the early 1990s, these sales come from surpluses. Afterwards, it will become necessary to build earlier the following hydroelectric projects: La Grande complex Phase II (LG 1, Laforge, and Brisay), Sainte-Marguerite, Grande Baleine complex, Ashuapmushuan and the Nottaway-Broadback-Rupert (NBR) Complex. The least expensive project, La Grande- Phase II, will be reassigned to Québec's growing needs between 1998 and 2003, and the same will apply to the other rescheduled projects.

It should be noted that if internal needs in Québec should grow more rapidly than forecast, the installations would be repatriated sooner.

Figure 26 - **Advancement of Projects for 3,500 MW Exports**

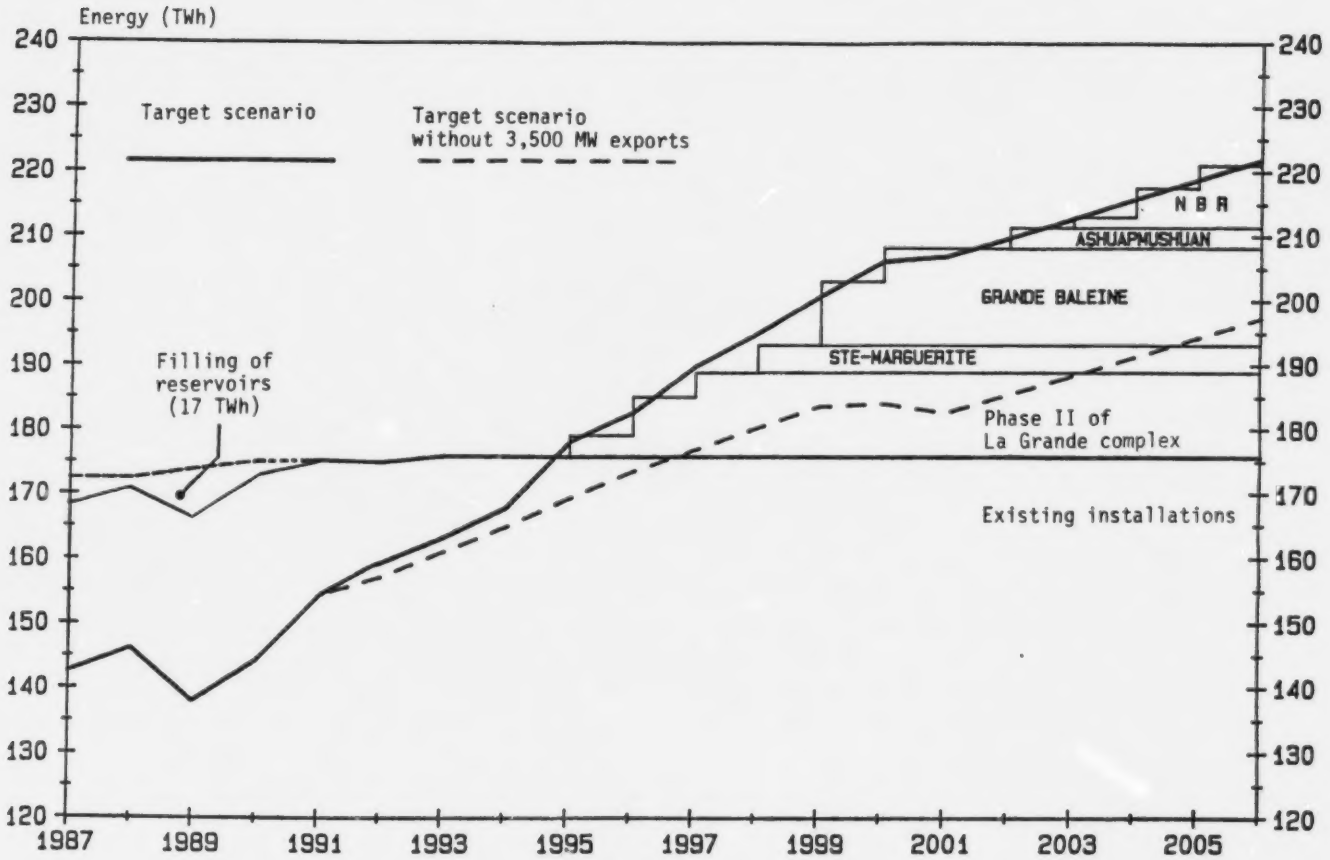


Table 14 - **Commissioning Dates of the Target Construction Program**

Projects	Maximum Power at system peak (MW)	Date of commissioning
Peak-Load Equipment		
- Manic 5 AC	980	1989
- LG 2 A (first three units)	950	1992
- LG 2 A (last three units)	950	1993
- Manic 3, 2, 1 AC	835	1995-1998
- Other peak-load projects	1,300	1995-2003
Base-Load Equipment		
- La Grande Complex Phase II		
. LG 1	1,296	1995-1996
. Brisay	385	1996
. Laforge 1	783	1997
- Sainte-Marguerite	822	1998
- Grande Baleine	2,891	1999-2000
- Ashuapmushuan	533	2001-2002
- NBR	8,700	2003-....

8.2.2 Decision Timetable

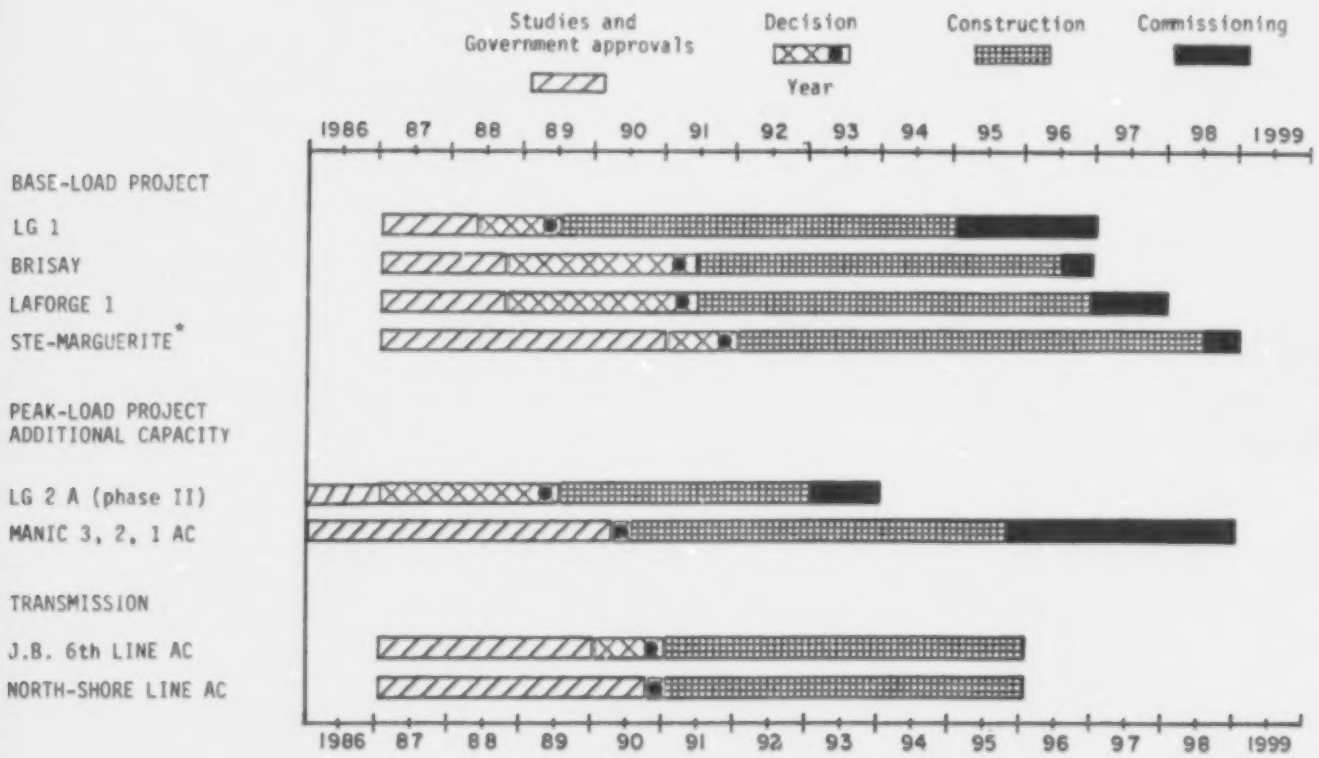
The first projects required have already been the subject of extended studies, so that the company could proceed very quickly to begin construction as soon as the necessary government approvals were obtained. For LG 1, Brisay and LA 1, studies will be finalized and government approval obtained in 1988, in order to be able to make decisions on these projects between 1989 and 1991 and start commissioning between 1995 and 1997. In the case of Sainte-Marguerite, studies should begin in 1987, so that the decision can be made in 1991 for commissioning in 1998.

For peak-load equipment projects, the company plans to commission the last three units at LG 2A in 1993. However, in view of the execution schedule for this project, the final decision could be made in 1989 at the latest. The additional capacity at Manic 3, 2 and 1 requires that studies be completed by 1988 to be able to commission this capacity between 1995 and 1998.

Parallel to the commissioning of this plant, Hydro-Québec will commission Radisson rectifier substation and the DC line of the James Bay transmission system in the fall of 1990, as well as Nicolet converter substation in 1992. Furthermore it expects to begin studies of the sixth AC line in the James Bay transmission system in 1987, in order to be able to have it available for the commissioning of the first units of the LG 1 powerhouse in 1995. Likewise, studies of an AC line to the North Shore should start in 1987 for the commissioning of the first units in the additional capacity of Manic 3, 2 and 1 starting in 1995.

Figure 27 shows the decision timetable for each of the projects planned until 1998.

Figure 27 - **Decision Timetable - Target Scenario**



* Obtaining of government approvals for Sainte-Marguerite may be postponed for one year.

8.2.3 Capital Expenditures

Table 15 presents all capital expenditures for the target construction program. Overall investments for the 1987-1996 period total $36.7 billion.

Table 15 **Target Construction Program Capital Expenditures**
(in millions of dollars)

	Types of installations	1987	1988	1989	1990-1996	Total 10 years	in %
Target scenario							
Growth at 2.7% with 3,500 MW of exports	Generation	408	752	887	14,567	16,614	45
	Transmission	530	1,061	1,245	7,028	9,864	27
	Sub-transmission	586	523	553	4,541	6,203	17
	Support and technology	261	276	305	2,682	3,524	10
	G.L.I.A*.	117	62	51	298	528	1
	Total	1,902	2,674	3,041	29,116	36,733	100

* G.L.I.A. : Grants, loans, investments and advances.

For information purposes, Table 16 shows the capital expenditures for large generating and transmission projects already approved.

Table 16 - **Capital Expenditures Related to Major Generating and Transmission Projects Already Approved**
(in millions of dollars)

Projects	At December 31, 1986	1987	1988	1989	Subsequent years 1990-1996	Total
Generation						
- Manic 5 AC	441	114	148	84	11	798
- LG 2 A (first three units)	59	75	150	220	649	1,153
- LG 2 A (last three units)	--	-	-	14	277	291
Transmission						
- 450 kV direct current line and Radisson and Nicolet substations	92	177	529	402	390	1,590

8.2.4 Energy Balance

The balance of electrical energy supply and demand shown in Table 13 parallels Hydro-Québec's total deliveries with the energy resources it expects to have available, mainly from commissioning new plant. This summary identifies the best way to arrange the energy supply to reliably satisfy the company's contract commitments and benefit from the opportunities on the surplus energy market, both in Quebec and for export.

The supply includes hydroelectric generation, thermo-electric generation and electricity purchases, mainly from Churchill Falls.

Table 17 - **Balance of Electrical Energy Supply and Demand (in TWh)**

	Historical						Forecast									
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
SUPPLY																
Hydroelectric generation																
- Run-off	77.8	93.5	100.5	121.7	105.6	102.0	133.4	133.7	134.0	134.2	134.5	134.5	135.0	135.9	138.8	142.1
- Plus variation (drawdown +, accumulation -)	+11.3	-14.1	-21.3	-14.5	+11.9	-4.8	-3.9	-1.8	-8.2	-2.9	+0.7	+1.4	-0.6	-0.2	+2.1	+1.6
- Less spilling	0.7	0.0	13.1	10.8	5.7	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	90.4	79.4	85.9	96.4	111.8	123.8	129.5	131.9	125.8	131.3	135.2	135.9	135.2	135.7	140.9	143.5
Thermal Generation	0.2	0.2	2.4	3.9	3.7	4.3	5.4	5.0	5.0	5.0	4.9	4.9	4.9	4.9	5.0	5.0
Electricity Received	29.1	28.6	34.1	38.5	34.5	32.8	34.9	34.9	35.6	35.6	35.3	35.0	34.8	34.5	34.2	34.2
Generation and Electricity received	119.7	107.6	122.4	138.8	150.0	160.9	169.8	171.8	166.4	171.9	175.4	175.8	174.9	175.1	180.1	182.7
Less Electrical Losses	9.7	10.2	11.2	11.8	12.6	13.6	14.2	14.8	14.3	14.8	15.1	15.4	15.3	15.7	16.2	16.6
Total Deliveries	110.0	107.2	111.2	127.0	137.4	147.3	155.6	157.4	152.1	157.1	160.3	160.4	159.6	159.4	163.9	166.1
DEMAND																
Sales in Québec																
- Firm	85.8	89.5	85.1	91.0	97.6	103.5	109.9	112.9	116.3	120.0	124.0	129.3	132.9	136.9	140.6	145.2
- Surplus	2.7	2.2	3.0	9.9	12.1	13.7	13.3	13.3	1.8	—	—	—	—	—	—	—
Subtotal	88.5	85.7	88.1	100.9	109.7	117.2	123.2	126.2	118.1	120.0	124.0	129.3	132.9	136.9	140.6	145.2
Export sales																
- Firm	5.7	5.8	6.7	6.3	6.9	7.0	5.1	5.1	5.0	6.8	11.9	10.6	11.5	12.2	14.2	16.9
- Surplus	12.7	13.1	12.9	16.6	17.3	19.9	24.0	22.8	23.0	26.3	20.4	16.5	11.1	6.9	3.1	—
Subtotal	18.4	17.9	19.6	22.9	24.2	26.9	29.1	27.9	28.0	33.1	32.3	27.1	22.6	19.1	19.3	16.9
Total Sales	106.9	103.6	107.7	123.8	133.9	144.1	152.3	154.1	146.1	153.1	156.3	156.4	155.4	155.4	159.9	162.1
Deliveries as per Agreement	3.1	3.6	3.5	3.2	3.5	3.2	3.3	3.3	6.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total Deliveries	110.0	107.2	111.2	127.0	137.4	147.3	155.6	157.4	152.1	157.1	160.3	160.4	159.4	159.4	163.9	166.1

8.3 Construction Program According to Various Scenarios of Domestic and External Demand

Commissioning Schedule

In order to evaluate the sensitivity of the construction program in terms of the development of Quebec markets, scenarios of weak and strong growth in demand for firm electricity in Québec are shown in the following table. These are compared to the Hydro-Québec target scenario and the reference scenario.

Table 18 - Construction Program According to Various Scenarios of Domestic and External Demand

Projects	Target scenario (2.7 %) (With supply and demand management and 3,500 MW exports)	Variability of domestic markets		
		Weak scenario (1.5%)	Strong scenario (3.5%)	Reference scenario (2.7%)
		(Without supply and demand management and without export of 3,500 MW)		
Peak-Load Equipment				
- Manic 5 AC	1989	1989	1989	1989
- LG 2 A (first three units)	1992	1992	1992	1992
- LG 2 A (last three units)	1993	2000	1993	1993
- Manic 3, 2, 1 AC	1995-1998	2005-2007	1996-2000	1995-1999
- Other peak-load projects	1,300 MW (1995-2003)	900 MW (2002-2004)	5,300 MW (1990-2002)	4,700 MW (1994-2003)
Base-Load Equipment				
- La Grande complex Phase II				
. LG 1	1995-1996	(a)	1994-1995	1996-1997
. Brisay	1996	(a)	1994	1998
. Laforge 1	1997	(a)	1995	2001
- Sainte-Marguerite	1998	(a)	1998	2004
- Grande Baleine	1999-2000	(a)	1997-1999	2005-....
- Ashuapmushuan	2001-2002	(a)	1998-1999	(a)
- NBR	2003-....	(a)	2002-....	(a)

(a) Commissioning after 2006.

Capital Expenditures

Table 19 shows total capital expenditures for the target scenario, as well as the weak and strong growth of demand for firm electricity in Québec.

Table 19 - **Annual Investments According to Various Scenarios**
(In Millions of Current Dollars)

Scenarios	1987	1988	1989	1990-1996	10 years Total
Target Scenario Growth of 2.7% with exports of 3,500 MW	1,902	2,674	3,041	29,116	36,733
Weak Scenario* Growth of 1.5% in sales of firm electricity in Québec	1,851	2,439	2,671	13,997	20,958
Strong Scenario* Growth of 3.5% in sales of firm electricity in Québec	1,902	2,641	3,557	35,262	43,362
Reference Scenario* Growth of 1.7% without exports of 3,500 MW	1,902	2,535	2,837	23,158	30,432

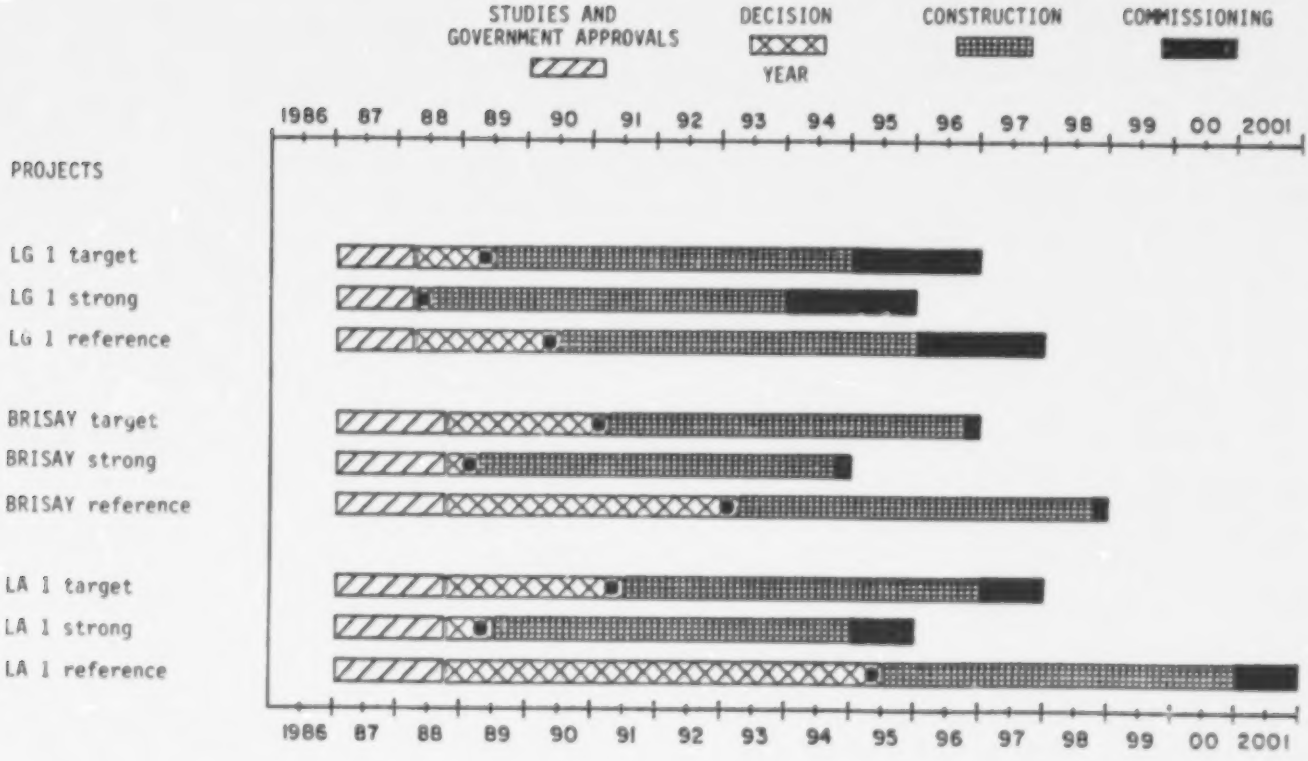
*Without exports of 3,500 MW.

8.4 Flexibility in Installations

The company must have flexibility to adapt rapidly to market changes.

The following figure shows that if there should be strong growth in domestic demand, the company could, if required, commission LG 1 one year earlier than in the target scenario, i.e. in 1994-95 instead of 1995-96. Likewise, Brisay could be commissioned in 1994 rather than 1996, and Laforge 1 in 1995 instead of 1997. These changes are made possible by completing the studies on the projects in Phase II of the La Grande complex in 1987 and obtaining permits by 1988.

Figure 28 - **Decision Timetable - Alternative Scenarios**



8.5 Objectives and Strategies

Objective 1

Plan the generating facilities and transmission system of Hydro-Québec both to satisfy contract commitments and provide the flexibility needed to adjust rapidly to changes in the markets while promoting the rational use of natural resources.

Strategies

1. Complete activities necessary to commission the additional capacity at Manic 5 in 1989.

2. Commission the first three units (950 MW) of additional capacity at LG 2 in 1992 and the last three (950 MW) in 1993. Also put in service Radisson converter substation and the 450 kV DC line in 1990 and Nicolet rectifier substation in 1992.

Continue steps to obtain government authorization to be able to begin work on LG 2A Phase I and Radisson-Nicolet-Des Cantons DC line in 1987. The decision on the second phase of LG 2A can be re-evaluated in 1989, according to the growth of Québec and external markets.

3. Prepare the decisions to be made starting in 1989 on generating and transmission equipment, to finalize the development strategy for Quebec and external markets. To do this,

Obtain for 1988 all necessary government authorization for execution of Phase II of the La Grande complex, which includes LG 1, Laforge 1 and Brisay, and begin studies on the sixth AC line of the James Bay transmission system in 1987.

Conduct studies in 1987 of the Grande Baleine complex, reviewing alternatives designed to shorten the construction timetable. To do this, complete studies on marine access.

Continue studies on the modular construction of the Grande Baleine and NBR complexes.

In 1987 undertake studies of the Sainte-Marguerite project, in order to be able to obtain government approval in 1990 and make a decision in 1991.

Parallel to this program, studies of additional capacity must be continued, in order to complete the studies for additional capacity at Manic 3, 2 and 1 by 1988 for commissioning in 1995.

Begin studies on an AC line to the North Shore in 1987 in order for this line to be available for the commissioning of the first units of additional capacity at Manic 3, 2 and 1, and pursue studies on the possibility of transmission lines passing under the St. Lawrence River.

4. Identify the environmental parameters likely to be impacted by the general development of a region, for example, the Northwest or the North Shore. Establish a research program to better understand the phenomena involved, define appropriate environmental resource management practices and include them in the decision-making process.

9. TECHNOLOGICAL DEVELOPMENT AND DIVERSIFICATION

9.1 The Issue

Hydro-Québec recognizes the strategic importance of technological development. As can be seen in other chapters, most areas of the company's activities offer major challenges for which technology is an essential component.

In the next few years, the replacement and modernization of installations will require greater technological development. Likewise, increasing electricity exports will require effort. These include better understanding of system behavior when new interconnections are commissioned. At the same time, new developments will be required in various fields, such as automatic control devices, remote controls, electrotechnologies and consumption management, in which the company must improve its expertise and skills.

Generation, transmission, distribution and new uses of electricity call upon major technological developments. The size of the company and the special nature of its installations necessitate innovation in many fields of technology. These efforts imply a complex structure where the operational groups and centralized research, development and demonstration (RDD) services must work together. In order to identify the company's priorities in technological development and harness strengths in their achievement, the company will implement mechanisms promoting technological discussion and a more efficient allocation of resources.

Technology will continue to play a decisive role in coming years. This means that all parties involved must understand what is at issue and what choices are available. Greater participation by a larger number of people in the challenges should be promoted. University research has proved to be a complement to the company's RDD activities. Finally, while satisfying the needs and improving the growth of the company, new technological products must also contribute to Québec's economic development and to maintaining or improving the quality of life of its citizens.

9.2 Orientations

In order to satisfy the short, medium and long term needs of the company, technological development activities must:

Help Reduce the Costs of Supplying Electricity

As the entity entrusted with exploiting Québec's hydroelectric resources, Hydro-Québec must constantly attempt to improve the efficiency of its facilities to keep electricity competitive for its customers. In this area, technological progress is key to the development of plant, automatic control devices or software that improve system management and operation.

Help Solve Technological Problems Related to Electricity Exports

Construction of new interconnections and increased exchanges between Hydro-Québec and neighboring power systems pose major problems of reliability and stability. For these reasons, multi-terminal DC interconnections must be the subject of advanced study and research, and software simulating the systems must be created. Moreover, the possibility of setting up a data base and centralized processing system for the interconnected systems in the Northeast will be studied.

Help Improve the Quality of Service, Occupational Health and Safety and Environmental Quality

Greater awareness of these concerns has already been responsible for stimulating new research, but a great deal remains to be done. For example, the reliability of the system must be increased by more advanced tools for monitoring, maintenance and diagnosis. The automation of tests will ensure maximum availability of equipment in the production and transmission system. Robotization of maintenance will make it possible to reduce risks for workers while being economical. Likewise, research in new methods for decontaminating oils containing PCBs will result in a safer environment.

Sustain Sales of Electricity by the Development and Distribution of Electrotechnologies

To support the development of internal markets, technology must be used to execute and demonstrate new equipment and processes using electricity. To do this, Hydro-Québec will continue to be associated with users and manufacturers of this equipment and will involve the new electrochemistry and electrotechnologies laboratory in Shawinigan, completed in 1986.

Promote the Commercial Exploitation of Technology and Expertise

Innovations, which satisfy the needs of the company first, must also contribute to the creation of leading-edge industries. Experience has shown that the transition from research to fabrication and commercial exploitation does not occur without sustained effort. First, the prospect of commercial and industrial spinoffs from research must be present from the project definition stage. This requires a detailed review of technical solutions already available, trends in technological supply, and the growth of the market consisting of other electricity companies. It is also important that the company's programs be completed by RDD work specifically aimed at the exploitation of its innovations and their use by industry. In some cases, the company may have to invest with its industrial partners in the commercial exploitation of its innovations. Furthermore, the company's expertise will continue to be demonstrated abroad through the actions of Hydro-Québec International.

Stimulate Innovation and Staff Participation

The importance of the technological choices requires the competence of all those concerned. This means that the company must have a climate favorable to innovation and rewarding any contribution. The organization of technological development activities must follow certain principles. This means that research management must accept rules that are appropriate for this activity and promote the emergence of expertise by a concentration of projects. Furthermore, the applied nature of Hydro-Québec research requires that operational and marketing groups play a hand in its orientation. To do this, a technological forum will be established. Its role will consist of selecting priority projects and allocating resources.

Likewise, test and demonstration activities require close collaboration among the centralized RDD services and other groups. From this perspective, the participation of all groups in the budgeting process will be encouraged.

9.3 Objectives and Strategies

Objective 1

Orient technological development activities more toward the achievement of the company's major objectives.

Strategies

1. Enhance participation of groups in the orientation and follow-up of RDD activities.

   In order to open up RDD and as a result bring it closer to the main objectives of the company, a technology forum will be established in 1987. Its main mission will be to identify the technological development priorities on a corporate and departmental level. This will promote a better defined orientation of IREQ's efforts. The forum should also result in concentrating resources in the company's major projects. In order to increase the responsibility of the parties, a customer-supplier type relationship will be gradually instituted: each internal customer will ultimately finance the RDD projects it requests, just as outside customers do. This method of operation should facilitate more rigorous monitoring of project progress and financing and enhance the value of the results.

2. Accentuate efforts in technological exploration and prospecting.

   Activities of this kind are intended to better define the state of knowledge of certain particular fields. This allows rationalization of the use of the company's resources by taking greater advantage of efforts expended elsewhere. Sustained technological exploration and prospecting allow the company to find the proper position in relation to markets and competition, evaluate its progress and select points for future breakthroughs. In this context, studies have already been set up of amorphous metals, artificial vision for robotics and expert systems. A balance must be achieved between research intended to satisfy company short and medium term needs and that required for the longer term.

3. Continue the development and demonstration of new processes using electricity.

Parallel to activities started in 1986, new projects executed in collaboration with industrial partners will soon be getting underway. These involve the application of various electrotechnologies to industrial processes, such as infrared, plasma and induction heating. Moreover, the research program at the new electrochemistry and electrotechnologies laboratory will be prepared in collaboration with industrial, governmental and university partners.

Objective 2

Increase the commercial value of technological development activities and make use of them as a means of diversification.

Strategies

1. Expand marketing of technological expertise and of testing and simulation laboratory services.

Using its world-renowned resources, the company intends to intensify its efforts in Québec and external marketing, in order to promote the maximum use of its laboratories, sale of its expertise, and participation in research programs for governments and private agencies.

2. Obtain a better understanding of the commercial potential of technological development activities in selecting projects and technical solutions.

In the consultation forum, emphasis will be placed from the earliest stages of project definition on the participation of all interested parties, including the units and subsidiaries actively involved in marketing, in order to increase the chances of commercial success. Likewise, the company intends to direct its RDD activities to reflect the marketing of technologies.

3. In fields associated with or related to energy, carry out industrial activities that make use of developed technologies.

In seeking the association of partners, Hydro-Québec expects to promote the emergence and development of leading-edge companies for international markets. This action will occur through the Nouveler Inc. subsidiary, in such fields as energy management, instrument and computer control systems related to energy, combined heating-ventilation-air conditioning systems, and the production of electricity from biomass. Moreover, the company will establish a venture capital fund intended to start up advanced technology companies.

Objective 3

Improve the organizational framework of technological development activities.

Strategies

1. Differentiate management according to the nature of RDD activities.

Since each of the administrative units of the Technology, International Affairs and IREQ Group has a distinct mission and style, the introduction of a new structure that differentiates research, simulation and testing, as well as innovation, will promote exchanges of expertise and services and improve control over the nature of the projects and their budgets.

2. Apply management by objective

Because Hydro-Québec is facing major challenges in the field of technological development, a method of management specifically adapted to corporate technology projects will allow the major objectives of the enterprise to be achieved while facilitating the pooling of expertise, greater responsibility, better follow-up of budgets and evaluation of the degree to which goals are achieved.

The development of technological innovation projects will be done by the creation of a task force consisting of the specialized staff required, including the initiator of the project. These resources will preferably be seconded from their usual duties and will work in task force mode from terms of reference, schedule and a budget defined at the outset and subject to evaluation at pre-determined stages.

3. Encourage innovation by a mechanism for evaluating suggestions and offering rewards.

The company will organize a new structure for collecting innovative suggestions from its personnel. This structure will have as its main goal analysis, evaluation of commercial potential and implementation of appropriate suggestions. It will also institute a system of incentives for innovations that result in economic benefits for Hydro-Québec.

10. HUMAN RESOURCES MANAGEMENT

10.1 Present Situation

Human resources management at Hydro-Québec has been marked by significant changes during the major periods of its growth. The initial phase of sustained growth ended in the early 1980s. It was followed by a second phase, whose major feature, the substantial imbalance between supply and demand in electricity, meant staff reductions. Today, the utility is preparing for the third phase to begin in the early 1990s, heralding a new stage in human resources planning and management.

10.1.1 A Period of Change

In the period of sustained growth, the number of permanent staff rose from 10,976 in 1965 to a peak of nearly 20,000 in 1983. In 1982, sales declined and prospects of long-term growth slowed. To reduce the financial imbalance that resulted, Hydro-Québec was forced to reduce its staff and redeploy personnel to reflect the new objectives. Priorities shifted from construction to operations and marketing. Budget-cutting and rationalization efforts, intended to maintain the lowest possible rates to support these sales efforts, resulted in a number of measures with a major impact on human resources.

Table 20 - Positions and Manpower

	Historical						Forecast		
	1981	1982	1983	1984	1985	1986	1987	1988	1989
Permanent Positions -Authorized in January	20,162	20,584	20,631	19,600	19,400	19,350	19,825	19,600	19,600
Permanent Staff*									
- Staff in January	18,635	19,482	19,959	18,975	18,560	18,208	18,470	19,003	19,193
- Hired during the year	1,263	802	146	217	595	487***	833	475	375
- Departures during the year									
. retirements	179	170	871	501	803	114	175	160	150
. other	237	155	259	131	144	111	125	125	125
- Staff on at December 31	19,482	19,959	18,975	18,560	18,208	18,470	19,203	19,193	19,293
Temporary Staff**									
- Operations	2,286	2,520	1,610	1,886	2,788	2,326	2,032	1,832	1,832
- Construction sites	906	521	262	186	195	242	361	580	540
- Decrees	419	488	114	114	180	181	155	250	230
Total	3,611	3,529	1,986	2,186	3,163	2,749	2,548	2,662	2,602
Management Staff-SEBJ Total person-years	2,163	1,366	982	485	200	121	169	208	215

* Excludes subsidiaries.
** Average based on 26 pay periods.
*** Includes the return of 11 employees from subsidiaries.

In practice, the new economic situation meant a reduction in outside recruiting and the establishment of staff recycling and redeployment programs. Staff reduction was also achieved by a major early retirement program, while costs were rationalized by reducing the lead in general remuneration for Hydro-Québec employees over those in large companies operating in Québec. Finally, the lightening of the hierarchical structure and decentralization of activities and resources brought decisions closer to the action, mainly to ensure better customer service.

Table 21 - **Staff Distribution Ratios**

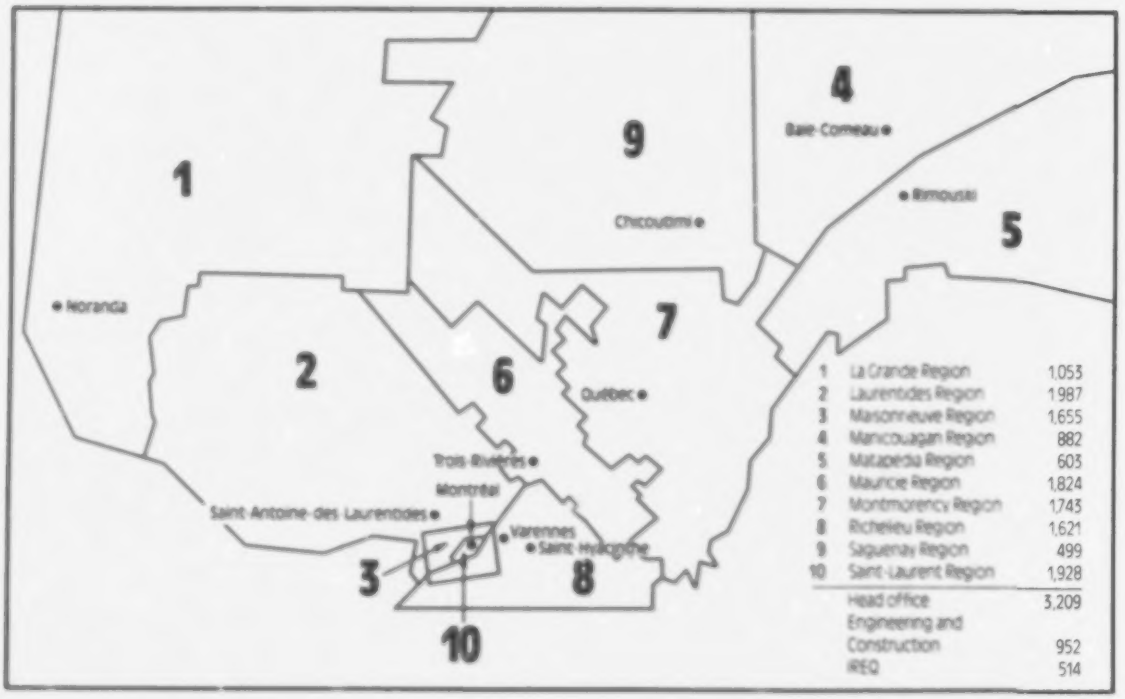
Ratios as at December 31	1982	1983	1984	1985	1986
Average number of staff per manager	6.74	7.53	8.51	9.48	9.51
Percentage of head office staff compared to total staff	22.68	19.72	19.52	17.73	17.37

Table 22 - Staff Breakdown by Administrative Unit
Job Group and Functions - December 1986

Job Groups		Managers	Specialists	Engineers	Technicians	Clerical	Trades	Total
ADMINISTRATIVE UNITS								
Regions								
La Grande		123	114	33	128	245	410	1,053
Laurentides		213	126	39	140	679	790	1,987
Maisonneuve		168	139	90	348	243	667	1,655
Manicouagan		101	57	23	143	165	393	882
Matapédia		67	59	13	62	188	214	603
Mauricie		214	135	95	225	396	759	1,824
Montmorency		192	133	41	174	552	651	1,743
Richelieu		172	121	35	139	563	591	1,621
Saguenay		66	38	14	59	120	202	499
Saint-Laurent		185	176	42	59	845	621	1,928
Subtotal	men	1,459	948	408	1,463	2,014	5,281	11,573
	women	42	150	17	14	1,982	17	2,222
	total	1,501	1,098	425	1,477	3,996	5,298	13,795
Head Office		389	1,236	303	107	932	242	3,209
Engineering and Construction		179	150	213	161	246	3	952
IREQ		33	39	172	134	74	62	514
Subtotal	men	557	1,106	658	395	386	291	3,393
	women	44	319	30	7	866	16	1,282
	total	601	1,425	688	402	1,252	307	4,675
TOTAL	men	2,016	2,054	1,066	1,858	2,400	5,572	14,966
	women	86	469	47	21	2,848	33	3,504
	total	2,102	2,523	1,113	1,879	5,248	5,605	18,470

Generation	Transmission	Distribution	Telecommunications	Marketing	Research	Others	Total
14%	15%	23%	3%	12%	3%	30%	100%

Map 3 - Geographic Distribution of Permanent Staff



1	La Grande Region	1,053
2	Laurentides Region	1,987
3	Maisonneuve Region	1,655
4	Manicouagan Region	882
5	Matapedia Region	603
6	Mauricie Region	1,824
7	Montmorency Region	1,743
8	Richelieu Region	1,621
9	Saguenay Region	499
10	Saint-Laurent Region	1,928
	Head office	3,209
	Engineering and Construction	952
	IREQ	514

10.1.2 A Period of Adaptation

Parallel to the short-term measures, Hydro-Québec began a longer-term adaptation, reflected in the amendments to the Hydro-Québec Act in 1983 that expanded its mission. While retaining its public nature and its objective of satisfying the electricity needs of Québec customers, the company is intensifying its sales efforts in Québec and looking more toward developing export markets.

This new challenge requires adaptation from the staff to meet the needs of a more demanding and less captive clientele than in the past.

To keep costs at an acceptable level, there must be continued control of growth in permanent staff assigned to operations, in spite of the promising development in the industrial sector and export markets. Thus, the needs for technological and administrative renewal, which in the past were mainly satisfied by outside recruiting, will have to be satisfied by expanded training, specialization and mobility by present staff. This limited growth in staff will affect all the company's partners, employees, unions and sub-contractors alike.

Furthermore, the company will be increasingly asked to collaborate more extensively with partners grouped according to their interests and affinities. Three quarters of the staff are already unionized and new groups have recently formed or are in the process of formation, such as first-level managers, pensioners and specialists.

Table 23 - **Permanent Staff by Union Accreditation, December 1986**

Union	Permanent Staff
- Syndicat professionnel des ingénieurs d'Hydro-Québec	1,098
- S.C.F.P. Section locale 957 - Techniciens(nes)	1,866
- S.C.F.P. Section locale 2000 - Personnel de bureau et PLT-CL (Projets de lignes de transport - Construction de lignes)	5,037
- S.C.F.P. Section locale 1500 - Métiers	5,363
- S.C.F.P. Section locale 1500 - Répartiteurs (CCR) (CER) (CED)	123
- Fraternité des constables spéciaux d'Hydro-Québec Constables - sergents	116

To deal with the 1990s, Hydro-Québec must make additional efforts to plan activities, especially work load and manpower. The adaptation to this new context is essentially a management task but it requires the collaboration of all personnel. Hydro-Québec intends to give its managers the necessary support and promote better communication with employees. After all, dialogue with Hydro-Québec's various partners is indispensable for executing the company's goals.

While pursuing its goals for meeting the challenges of the 1990s, Hydro-Québec intends to undertake short-term actions in two areas: relations with particular employee groups and review of policies or practices requiring adjustment.

10.2 Objectives and Strategies

Objective 1

Continue collaboration with various groups of employees to harmonize their objectives with those of Hydro-Québec.

Strategies

1. Establish a succession program to prepare first-level managers.

   The recent reorganization made major changes in the nature of division manager positions. Divisions include more diversified activities than previously, and their managers have increased approval powers. Moreover, the company has higher expectations of those in charge of these administrative units with respect to management.

   The goal of the program is therefore to prepare the next group for second level management through a pilot project involving a sample of first-level managers.

2. Increase the representation of women inside the company.

   In 1984, the company adopted an equal employment opportunity policy and appropriate guidelines. It then established consultation mechanisms and programs for raising awareness.

   Since 1985, the company has had quantitative goals for the outside hiring of female personnel. These ratios are revised annually and are closely monitored. It has proved to be timely to use additional measures for catching up, in order to improve the rate of female representation.

   A program to prepare women for managerial positions will continue in 1987. Analysis of this program will be used in revising the scale of efforts undertaken in this area. Access to non-traditional jobs will be promoted by a test project involving line workers. Efforts will also be continued to enhance recruitment of women for skilled trades.

Table 24 - Recruiting of Permanent Female Staff in Groups Where Women are Under-represented

	1985-1986			1986-1987			Representation of women (December 1986)
	Women selected		Number of positions filled (**)	Women selected		Number of positions filled (**)	
	Objective	Results (*)		Objective	Results (*)		
Outside Recruiting							
- Staff managers	-	11%	19	33.3%	0%	3	4.1%
- Specialists	30%	32%	65	50.0%	52%	23	18.6%
- Engineers	10%	21%	28	33.3%	0%	6	4.2%
- Technicians	5%	8%	13	25.0%	25%	4	1.1%
- Trades	5%	1%	235	5.0%	1%	105	0.5%
- Police	5%	0%	11	33.3%	50%	2	5.1%
Inside Recruiting							
- Staff managers	25%	9%	254	25.0%	13%	104	
- Specialists	-	25%	266	33.3%	19%	142	

* Because the objectives are set in July, the 1985-86 results cover the period from July 1, 1985 to June 30, 1986, and those for 1986-87, from July 1, 1986 to December 31, 1986.
** Men and women.

3. Introduce an assistance program for employees with substance abuse problems.

In the past, employees suffering from substance abuse were able to benefit from assistance programs offered at the initiative of some company units.

In order to make this type of support more generally available to all staff, Hydro-Québec has begun a program jointly with union representatives to introduce this assistance in 1987.

Resources will be made available to employees who express the need and the company will facilitate access to public and private rehabilitation services.

4. Collaborate in the formation and operation of an association of Hydro-Québec retirees.

Recent discussions on the operation of the pension plan revealed increased interest on the part of participants about the Hydro-Québec pension plan, especially by retirees. Their number has doubled in the last four years, rising from 2,870 in 1982 to 5,259 in 1986. Of these, 2,200 were people who took advantage of the early retirement incentive program.

The retirees have decided to form an association and would like concrete collaboration from Hydro-Québec. During 1987, the company, which supports such a step, will clarify the nature of the support it will give the retirees' association and put the assistance, which began in 1986, on a more permanent footing.

Objective 2

Revise policies and practices which require adaptation to a new human resources management context.

Strategies

1. Review the universality of benefit plans.

Some groups of employees have questioned the universality of benefit plans and are seeking to select their own benefits. They also express the desire to influence or control the decisions affecting their benefits.

The collective agreements now provide for parity committees to study accommodations in the insurance and retirement plans, in response to particular needs.

The company is also planning to continue, in 1987, the review and study of all benefit plans, in order to be able to take an informed position between universality and personalization of benefits.

2. Adjust compensation policy to the new economic context and the company's orientations.

Major modifications in the economic context in recent years have had an impact on compensation policies of large companies. New Hydro-Québec orientations, described in the Development Plan, imply a review of methods of compensation, intended to apply greater rationalization to the components of overall remuneration. Hydro-Québec proposes to study the content of a number of compensation programs and, where appropriate, modify its compensation policy to make it more competitive with that of other large Québec companies.

3. Identify the adjustments in work time that will best reconcile employee career and personal aspirations and the needs of the company and measure their feasibility.

The company has been committed to more flexible work time for several years. This includes the 8-6 schedules at James Bay and the variable schedules which now apply to most clerical workers, technicians, specialists, engineers and managers.

In 1986, Hydro-Québec began with the union to study the appropriateness of introducing, at fixed intervals, four-day weeks for employees ineligible for variable hours.

While continuing this study, Hydro-Québec intends to pursue its review of all current policies, in order to be able to propose programs at a later date that reflect the special requirements of employees or groups of employees.

4. Measure the impact of contracting out on employment, to adjust policies and practices in this area.

In order to update the policies and practices on contracting out, in effect for a number of years, Hydro-Québec is currently identifying the expenses and activities associated with all work contracted outside the company. This exercise will make it possible to measure the impact of contracting-out on employment in various manpower categories and establish a new balance in the allocation of work. In 1985, a preliminary evaluation model was prepared. The gradual implementation of this model in 1987 and 1988 will make it possible to obtain the information needed for the required modifications.

5. Adapt equipment, work methods and the labor code to regulations on the use of safety locking devices.

   Government health and safety regulations require that workers ensure their safety by using individual safety locking devices during the execution of certain tasks.

   In 1987, the company will complete the introduction of work methods modified to reflect these regulations and should thereby integrate them in the labor standards governing work methods on the systems. Likewise, the company's labor code, which dates from 1976, will be updated.

   In this same area, to ensure the safety of staff and the public while giving adequate attention to customer service, the company plans, this year, to choose criteria to guide the selection of work techniques on live or out-of-service equipment.

11. FINANCIAL MANAGEMENT

11.1 Present Situation - Increase in the Company's Overall Risk

Recent developments in Hydro-Québec's financial situation testify to the utility's vulnerability in an increasingly unpredictable economic and energy context. This greater vulnerability is a permanent factor, which must be taken into account in the company's planning. Moreover, the implementation of the development plan's strategy will substantially modify the composition of the risks that may affect the company.

Thus, development of external markets will focus on earlier construction of facilities, which introduces other elements of uncertainty: long-term price formulas not directly related to Hydro-Québec costs, at least for the second stage of external market development; large individual contracts; and the possibility of not finding outlets in Québec for energy when export contracts run out. However, by enabling the utility to replace sales of surplus energy with sales of firm power and energy, this strategy will in fact reduce the risks associated with price fluctuations of fuels.

Moreover, the company has made commitments in risk and profit sharing contracts with customers that are heavy users of electricity. This strategy is intended to give maximum stimulation to economic development in Québec, while recovering on average the costs of supplying electricity during the life of the contracts without making other consumers bear the burden of the discounts traditionally granted to attract industries. However, if the economic situation were unfavorable for several years, these contracts would temporarily be less profitable for Hydro-Québec.

Other strategies, intended to reduce the average costs of the company, will expose it to higher costs in some years. In these cases, there must be a tradeoff between minimizing costs and minimizing risks. Tight management of water reserves, for example, which reduces fixed costs, in years of low runoff can result in forced recourse to other measures, such as the operation of oil-fired generating stations or, as a last resort, purchases from neighboring systems. The same applies to borrowing strategies using variable interest rates rather than fixed rates. Variable-rate debt can be less expensive than fixed rate, but in some years, the opposite can be the case.

Finally, some strategies will reduce the risks to which the company is exposed. This is the case of external market development strategies, which reduce exchange risks by providing a better balance in American dollar inflows and outflows. The same applies to all the market development strategies, both Québec and external: by speeding up the gradual disappearance of surplus energy sales to be replaced by firm energy and power sales, vulnerability to fuel price fluctuations can be reduced.

Overall, the proposed development strategies will modify the nature of the general risk faced by Hydro-Québec and will increase its scale over previous years. In return, the company will be able to significantly reduce its costs of supply and ensure the exploitation of its hydroelectric resources by the dynamic and profitable development of Québec and external markets.

11.2 The Necessity for Improving Financial Performance

What, concretely, do these risks mean? They mean that in some years, Hydro-Québec may face a combination of revenue shortfalls and additional expenses. The company's planning must take these possibilities into account and sufficient margin for maneuver beyond its minimum financial criteria must be created.

Hydro-Québec was able to preserve a solid financial position until 1984 by remaining competitive on the markets. This was because it had, at the outset, a sound financial situation with sufficient room for maneuver. Until 1984, despite surpluses of electricity and falling exchange rates, Hydro-Québec generally respected its minimum financial criteria. In 1985 and 1986, however, the company no longer had sufficient margin for maneuver to completely absorb the additional shocks on the energy and exchange markets. This caused some financial ratios to fall below the minimum, such that no dividend could be declared. Thus, the capitalization ratio was somewhat below the minimum level of 25%, while the return on equity was falling well below the cost of the debt, amounting to 4.4% in 1986.

Table 25 - **Financial Performance by Hydro-Québec**

	1980	1981	1982	1983	1984	1985	1986*
Interest coverage	1.18	1.01	1.01	1.04	1.10	1.12	1.15
Capitalization ratio (%)	25.5	25.1	26.1	26.6	25.3	24.1	24.0
Return on equity (%)	18.6	12.0	15.0	11.7	4.7	3.2	4.4
Net income ($ million)	746	559	800	707	301	209	303
Net income/earnings from electricity (%)	30.9	20.2	24.6	19.7	7.3	4.7	6.5

* Estimate.

Without the margin for maneuver available in the early 1980s, the deterioration of Hydro-Québec ratios would have been much greater, with consequences for its credit rating and that of Québec. To avoid these consequences, it could have been forced to increase rates substantially in a particularly difficult period.

Recent experience has thus shown the necessity for two actions: restore the minimum financial criteria in the short term, then, in the medium term, find sufficient margin by a realignment of all financial ratios. Without this margin, any major disruption in the company's environment would mean sudden rate hikes in electricity's captive markets, an unacceptable choice, or further worsening of the financial criteria, which could seriously harm the government's credit rating. Hydro-Québec's debt is 47% of debt contracted and guaranteed by the Québec government, which represents for its part 45% of Québec's GDP. Annual refinancing of $1 billion needed over the coming years requires regular access to the financial markets.

A margin for maneuver is thus necessary to ensure rate stability and to allow borrowing at attractive terms. This is fundamental if Hydro-Québec is to again invest in large generating facilities in the early 1990s. It is also necessary to establish a policy of dividends that reflect the profitability of the company and its self-financing needs.

11.3 Objectives and Strategies

Objective 1

In a first stage, over the next three years, regain or maintain three of the four minimum financial criteria: interest coverage ratio equal to or greater than 1.0; capitalization ratio of at least 25% and self-financing of at least 30%.

In the next stage, create a margin for maneuver that restores the traditional criterion of return on equity that is equal to or greater than the cost of the debt and increase the ratios of the criteria in order to better reflect the company's risks.

> The recovery of the financial situation and reconstitution of a margin for maneuver will come from reabsorption of the imbalance in supply and demand. This will allow kilowatt-hours, now sold at a discount on surplus energy markets, to be sold at prices that better reflect the costs of supply. It will also result from cost reduction strategies and application of the rate policy.

Strategies

1. Continue cost reduction efforts, maintaining the gains achieved over the last four years with respect to operating expenses and applying progressively supply management and debt management strategies.

2. Seek profitable export markets that allow a margin for maneuver compatible with the specific risks.

3. Establish electricity rates according to a rate policy that is more consistent with the cost price and provides a return on equity greater than the cost of the debt.

This rate policy implies rate rises which, on average, should follow general inflation. If increases substantially below inflation are allowed in the short and medium term, it would interfere with the reconstitution of a margin for maneuver that is compatible with the risks associated with Québec markets and could challenge some of the long-term cost reduction strategies.

Objective 2

Seek to reduce financing costs and exercise closer management of financial risks, in order to minimize their impact on the company's results, rates and dividends.

Strategies

1. Share a portion of the financing and financial risks of riskier activities with partners.

2. Continue to maximize the share of financing in Canadian currency, and use other methods to minimize the exchange risk. In particular, take advantage of the exchange coverage resulting from the development of external markets.

3. When negotiating new debt or renewing loans, terms of ten years and more are to be preferred.

4. In order to reduce or stabilize the cost of debt, refinance loans that can be recalled when it is economical to do so. This refinancing will also provide better distribution of maturity dates.

5. Study and introduce any means that may, in the short term, reduce the volatility of the cost of debt servicing and thus reduce the impact on results, such as term contracts or options.

6. Gradually increase the portion of the debt at variable rates to the extent that this will restore the financial margin for maneuver.

11.4 The Financial Framework of the Target Scenario

The financial framework of the target scenario describes the source and allocation of resources necessary for Hydro-Québec to accomplish its purposes and achieve its development plan. It is thus a financial forecast based partly on the present situation of the company and its financial management orientations and partly on a series of assumptions taken from the most probable economic and energy scenarios. The following tables present the financial framework for 1987, 1988 and 1989, the underlying assumptions for the main parameters and the corresponding changes in financial ratios.

The application of a rate policy that seeks to gradually reflect cost prices, combined with cost-cutting efforts, contributes to gradual improvement in the company's financial situation and allows it to restore three of the traditional minimum financial criteria by 1989.

Thus, the interest coverage ratio and the self-financing ratio will remain above 1.0 and 30% respectively. The capitalization ratio achieves its minimum level of 25% in 1989, and that year, the return on equity comes very close to the average cost of debt.

Table 26 - **Financial Framework of Target Scenario**
Main Parameters

Parameters	Historical		Forecast		
	1985	1986	1987	1988	1989
Rate of growth of Québec's real gross domestic product (%)	4.3	3.3	2.8	2.8	2.8
Rate of growth of sales volume (%)					
- Sales of firm electricity in Québec	7.3	6.0	6.2	2.7	3.0
- Sales of surplus electricity in Québec	22.2	13.2	(2.9)	-	(86.5)
- Export sales	5.7	11.2	8.2	(4.1)	7.5
- Total sales	8.2	7.6	5.7	1.2	(3.9)
Average rate increase* (%)	2.5	5.4	4.9	5.2	5.2
Rise in Consumer Price Index (%) Montréal (%)	4.4	4.9	4.4	4.7	5.2
World price of crude oil in $US	27.5	15.1	16.0	17.0	18.0
Interest rate on Hydro-Quebec bonds for 10 years and longer (%)					
- Canadian market	11.6	9.9	10.2	11.0	10.8
- US market	11.7	9.1	9.2	9.8	10.7
Rate of exchange of Canadian dollar					
- American dollar	0.715	0.724	0.715	0.715	0.722
- German mark	1.75	1.39	1.34	1.40	1.40
- Swiss franc	1.47	1.17	1.11	1.12	1.13
- Yen	143.0	114.5	107.3	103.5	103.2

* On May 1 of each year, according to assumptions used for 1987, 1988 and 1989.

Table 27 - **Financial Framework of Target Scenario Results (in millions of dollars)**

Elements	Historical		Estimate		Forecast					
	1985		1986		1987		1988		1989	
	$	%	$	%	$	%	$	%	$	%
Average rate increases		2.5		5.4		4.9		5.2		5.2
Revenues										
- Sales of firm electricity in Québec	3,541	7.6	3,857	8.9	4,187	8.6	4,504	7.6	4,865	8.0
- Sales of surplus electricity in Québec	209	26.7	167	-20.1	119	-28.7	151	26.9	24	-84.1
- Export sales	673	4.3	649	-3.6	641	-1.2	677	5.6	736	8.7
- Other operating revenues	69	-4.2	61	-11.6	62	1.6	66	6.5	69	4.5
Total operating revenues	4,492	7.6	4,734	5.4	5,009	5.8	5,398	7.8	5,694	5.5
Expenditures										
- Operating expenes, including:	1,163	5.2	1,129	-2.9	1,196	5.9	1,314	9.9	1,453	10.6
amortization of write-offs	90	13.9	93	3.3	15	-83.9	15	0.0	0	-100.0
- Other operating expenditures	787	3.8	854	8.5	910	6.6	966	6.2	1,027	6.3
Total operating expenditures	1,950	4.6	1,983	1.7	2,106	6.2	2,280	8.3	2,480	8.8
Income before interest and exchange losses	2,542	10.1	2,751	8.2	2,903	5.5	3,118	7.4	3,214	3.1
- Interest	2,075	16.2	2,259	8.9	2,282	1.0	2,208	-3.2	2,232	1.1
- Exchange losses	258	15.7	189	-26.7	277	46.6	223	-19.5	206	-7.6
Interest and exchange losses	2,333	16.2	2,448	4.9	2,559	4.5	2,431	-5.0	2,438	0.3
Net income	209	-30.6	303	45.0	344	13.5	687	99.7	776	13.0
Dividends likely to be declared	0	--	0	--	0	--	0	--	292	--
Gross interest charges	2,322	6.9	2,412	3.9	2,502	3.7	2,572	2.8	2,720	5.8
Gross capital expenditures	1,615	-3.9	1,537	-4.8	1,902	23.7	2,674	40.6	3,041	13.7
- Less: interest charged to construction	181	-39.7	128	-29.3	186	45.3	350	88.2	472	34.9
- Net capital expenditures	1,434	3.8	1,409	-1.7	1,716	21.8	2,324	35.4	2,569	10.5
External Financing										
- Net bond issue	1,952	67.7	1,809	-7.3	2,195	21.3	1,995	-9.1	2,256	13.1
- Less: redemption and maturities	1,228	61.8	1,050	-14.5	1,383	31.7	946	-31.6	945	-0.1
- Net borrowing	724	78.8	759	4.8	812	7.0	1,049	29.2	1,311	25.0

Table 28 - **Financial Framework of Target Scenario**
Principal Financial Ratios

	Historical	Estimate	Forecast		
	1985	1986	1987	1988	1989
Return on equity (%)	3.16	4.41	4.77	8.91	9.35
Interest coverage	1.12	1.15	1.18	1.22	1.19
Capitalization ratio(% of equity)	24.11	23.95	23.98	24.84	25.00
Self-financing (%)	35.70	41.01	35.61	41.89	33.01

	Method of Calculation
Return on Equity	$\frac{\text{Net income of year}}{\text{Shareholder's equity (average of year)}}$
Interest coverage	$\frac{\text{Income before interest and exchange losses} + \text{Net investment income}}{\text{Gross interest charges*}}$
Capitalization ratio	$\frac{\text{Shareholder's equity}}{\text{Shareholder's equity} + \text{Long-term debt} + \text{Notes payable} + \text{Long-term debt due in less than a year} + \text{Public debt}}$
Self-financing	$\frac{\text{Total income from operations of financial resources} - \text{Declared dividends}}{\text{Capital expenditures} + \text{Redemption of debentures and other long-term debt}}$

* Interest on long-term debt
+ Interest on public debt
+ Interest on bank advances and notes payable
+ Amortization of debenture discount and expenses

11.5 Sensitivity Analysis

Financial forecasts are subject to unpredictable events in the economic and energy environment, since the underlying assumptions are subject to major variations. In the short and medium term, the changes in oil prices and the value of the Canadian dollar are potential sources of the greatest variations in the company's financial forecasts, although interest rate developments could also constitute a disruptive element.

The current financial forecasts are made in an economic context of growth. As recent years have clearly shown, however, a large variation in economic parameters may have a major impact on the financial results included in this framework.

Table 29 - **Sensitivity of 1987 Net Income to Variations in the Main Parameters**

Parameters	Variations	Variations in net income (In millions of $)
Volume of sales of firm electricity in Québec	+ 1%	42
Volume of sales of surplus electricity in Québec	+ 1%	1
Volume of export sales	+ 1%	6
Rates	+ 1% as from May 1st	23
World price of crude oil	+ 1 US $/BBL	19
Operating expenses	+ 1%	- 12
Interest rates	+ 1%	- 24
Exchange rate of Canadian dollar (in $US)*	+ 1 cent	26
Exchange rate of Canadian dollar in terms of the basket of currencies other than the American dollar	+ 1%	10

*Impact of exchange on interest charges in US dollars and on the exchange loss in US dollars incurred on maturity dates during the year.

11.6 Comparison of the Principal Elements of the Financial Framework for 1986 and 1987

The 1986 economic context was marked by a deeper fall in the price of oil than anticipated by Hydro-Québec in last year's plan. Forecast at US$20 per barrel for the 1986-1988 period, the average price in 1986 was about US$15. Last year's forecast assumed that the exchange rates in effect on December 31, 1985 would remain constant for all currencies. While the Canadian dollar has in fact remained reasonably stable compared to its US counterpart, it has lost up to 20% compared to European and Japanese currencies. In spite of the fall in oil prices and the value of the Canadian dollar, Hydro-Québec has been able to protect its financial situation, posting net earnings in 1986 that were higher than those forecast last year. The following table provides a comparison for 1986 and 1987 of the financial framework of the 1986-1988 development plan with this year's.

It should be noted that as decided last year, Hydro-Québec results in 1986 reflect the exchange coverage provided by its income in US dollars against the exchange loss risks to which it is exposed by debts denominated in that currency. No write-down for potential exchange losses on debts in American currency subject to this coverage is therefore made.

Two main modifications have been made to the application of this method since last year. First of all, exchange coverage is no longer deducted from export revenues but included in the Exchange Losses item. Secondly, the write-down made in 1984 and 1985 on issues that are now the subject of this coverage will reduce the exchange loss of these series at maturity rather than being entirely recovered in 1986. The first of these modifications means a slight improvement in interest coverage, while the second somewhat delays achieving the objective of a capitalization ratio of 25%.

Table 30 - **Comparison of Forecasts for the Main Elements of the Financial Framework** (in millions of dollars)

Elements	1986			1987		
	Plan 1986-1988	Plan 1987-1989	Difference	Plan 1986-1988	Plan 1987-1989	Difference
Revenues						
- Sales of firm electricity in Québec	3,696	3,857	161	4,029	4,187	158
- Sales of surplus electricity in Québec	165	167	2	182	119	-63
- Export sales*	678	649	-29	691	641	-50
- Other operating revenues	63	61	-2	65	62	-3
Total operating revenues	4,602	4,734	132	4,967	5,009	42
Expenditures						
- Operating expenses	1,201	1,129	-72	1,233	1,196	-37
- Other operating expenditures	841	854	13	877	910	33
Total operating expenditures	2,042	1,983	-59	2,110	2,106	-4
Income before interest and exchange losses	2,560	2,751	191	2,857	2,903	46
- Interest	2,216	2,259	43	2,255	2,282	27
- Exchange losses**	211	189	-22	236	277	41
Interest and exchange losses	2,427	2,448	21	2,491	2,559	68
Net income	133	303	170	366	344	-22
Dividends likely to be declared	0	0	0	3	0	-3
Gross intrest charges	2,401	2,412	11	2,500	2,502	2
Gross capital expenditures	1,580	1,537	-43	2,230	1,902	-328
- Less: interest charged to construction	153	128	-25	204	186	-18
- Net capital expenditures	1,427	1,409	-18	2,026	1,716	-310
Financial ratios						
- Return on equity (%)	1.91	4.41		4.93	4.77	
- Interest coverage	1.08	1.15		1.16	1.18	
- Capitalization ratio (%)	24.93	23.95		25.00	23.98	
- Self-financing (%)	43.38	41.01		32.15	35.61	

* 1986-1988 Plan

	1986	1987
Net revenues from export sales	591	599
Exchange coverage	87	92
Revenues from export sales	678	691

** 1986-1988 Plan

	1986	1987
Exchange losses without exchange coverage	124	144
Exchange coverage	87	92
Exchange losses	211	236

11.6.1 Income from Sales

Because of the good performance of the Québec economy in 1986, revenues from sales of firm electricity in that year and those projected for 1987 are higher than the forecasts in last year's plan, by $161 and $158 million respectively. The assumption of a rate increase of 4.9% effective May 1, 1987, that was used in preparing the financial framework, is unchanged from last year.

However, the impact of the fall in oil prices resulted in a downward revision of revenues from sales of surplus electricity in Québec and for export of $27 million in 1986 and $113 million in 1987.

11.6.2 Operating Expenses

In 1986, excluding the new accounting for pension plans costs, operating expenses remained within the limits projected in the 1986 plan. For 1987, however, because of catching up in the plant maintenance programs affected by previous years' budget cuts, the company has increased the forecast from last year by 2%.

The amortization of the write-off of study costs for the NBR project ended in 1986 with the last $79 million installment. Furthermore, starting in 1986, study costs for the Delaney project, some $44 million, are being written off, amortized over three years.

The increase in other operating expenses projected in this forecast is due primarily to the re-evaluation of the depreciation of capital investments and the increase in taxes.

11.6.3 Accounting Practices for Pension Plan Costs

Since 1986, Hydro-Québec has applied the new accounting standards published by the Canadian Institute of Chartered Accountants. These rules define how Canadian companies must now reflect the costs and profits resulting from their pension plans in their financial statements.

The goal of these new accounting rules is to ensure that a company's financial statements reflect the cost of pension plans relative to a given financial year in terms of the actuarial hypotheses considered most probable by the management of the company. Previously, the cost of the plans was equal to the contribution of the employer, determined to ensure the capitalization of the plans.

Application of these standards in 1986 results in an expense for the pension plan of $9 million, while contributions made in this respect amounted to $84 million.

11.6.4 Interest Expenses

Interest expenses in 1986 were some $43 million more than forecast in last year's plan, mainly because of the depreciation of the Canadian dollar compared to the main European and Japanese currencies. For 1987, the current forecast is slightly higher than one year ago. The effect of the renegotiation of loans at lower interest rates largely offsets the weaker value of the Canadian dollar compared to last year.

11.6.5 Exchange Losses

In 1986, an intensification of exchange coverage operations and renegotiation of loans allowed a $22 million reduction in exchange losses on reimbursement of capital forecast last year. For 1987, this effort will substantially absorb the increases in the exchange loss currently projected because of the deterioration in the Canadian dollar.

11.6.6 Capital Expenditures

Net capital expenditures for 1986 and 1987 are $18 million and $310 million below forecast. The main reasons for this reduction are the postponement of certain projects -- reinforcement of the Daniel Johnson Dam and the Robertson, Chelsea and Farmers projects -- in order to execute other studies identifying more effective solutions. The drop is also the result of a more accurate estimate of the costs of the Radisson-Nicolet-Des Cantons DC line and the program for improving the transmission and sub-transmission system.

11.6.7 Debt

Hydro-Québec's debt at the end of 1986 was $22 billion, an increase of $1 billion over the previous year. A similar increase is expected in 1987.

The absolute and relative size of the Hydro-Québec debt has become considerable. It has more than quadrupled since 1975, when it amounted to $5 billion. On a unit basis, debt per customer has more than tripled during the same period, reaching $7,800 at the end of 1986. Thus, debt servicing has required disbursements for interest of the order of $2.4 billion in 1986 or 51% of revenues, a proportion that was 39% in 1975.

Likewise, since half of this debt is in foreign currency, its cost is subject to exchange rate fluctuations. Hydro-Québec is primarily involved in the energy sector and in recent years its revenues have been affected by the collapse of oil prices, but the unfavorable development of exchange rates has had just as marked an effect on its results and was the main reason that no dividend was paid.

Although Hydro-Québec has been involved in an ambitious SWAPS program that has made it possible to reduce the size of debt in foreign currency by about $1.7 billion since 1983, during this same period the debt has grown by a similar amount simply because of the devaluation of the Canadian dollar compared to other currencies. The unrealized exchange losses on debt in foreign currencies has grown from $876 million at December 31, 1983 to about $2.6 billion at the end of 1986.

12. IMPACT OF HYDRO-QUEBEC'S STRATEGIES ON ITS PARTNERS

Hydro-Québec's activities fall within a network of objectives that reflect the expectations of its partners: customers, the government shareholder, lenders and other parties. This context, which is specific to Hydro-Québec, determines its choice of strategies and the criteria by which its performance may be judged.

Hydro-Québec must first assume the role of public utility, responding to the needs for electricity of all of Québec at the best possible terms. In this respect, a balance between quality of service, rates and rate stability must be achieved. Furthermore, Hydro-Québec must also assume important responsibilities in developing the province's economy. It must seek out profitable opportunities for market development and attempt to optimize, for the benefit of Québec society, the benefits associated with its activities in generating and marketing electricity. The company must also respect the minimum requirements of the financial markets in order not to mortgage the government's guarantee of its debt.

This chapter is intended to clarify the optimization the Development Plan seeks to achieve, first by explaining the interrelations between the strategies adopted, i.e. the internal consistency of the plan, and then the tradeoffs required to reconcile the sometimes contradictory objectives of the various partners. Finally, the impacts of the Development Plan will be described, in terms of the two principal roles of the company: public utility and instrument of economic development.

12.1 Consistency and Interrelationships of Hydro-Québec's Strategies

As indicated in Chapter 2, Hydro-Québec's double role as public utility and instrument of economic development causes it to focus its Development Plan on three main concerns: Québec and external market development and cost reduction. The development of profitable markets brings economic spinoffs both from Hydro-Québec's activities and also from those of its Québec customers. The cost reduction program supports market development and contributes to creating financial margin for maneuver.

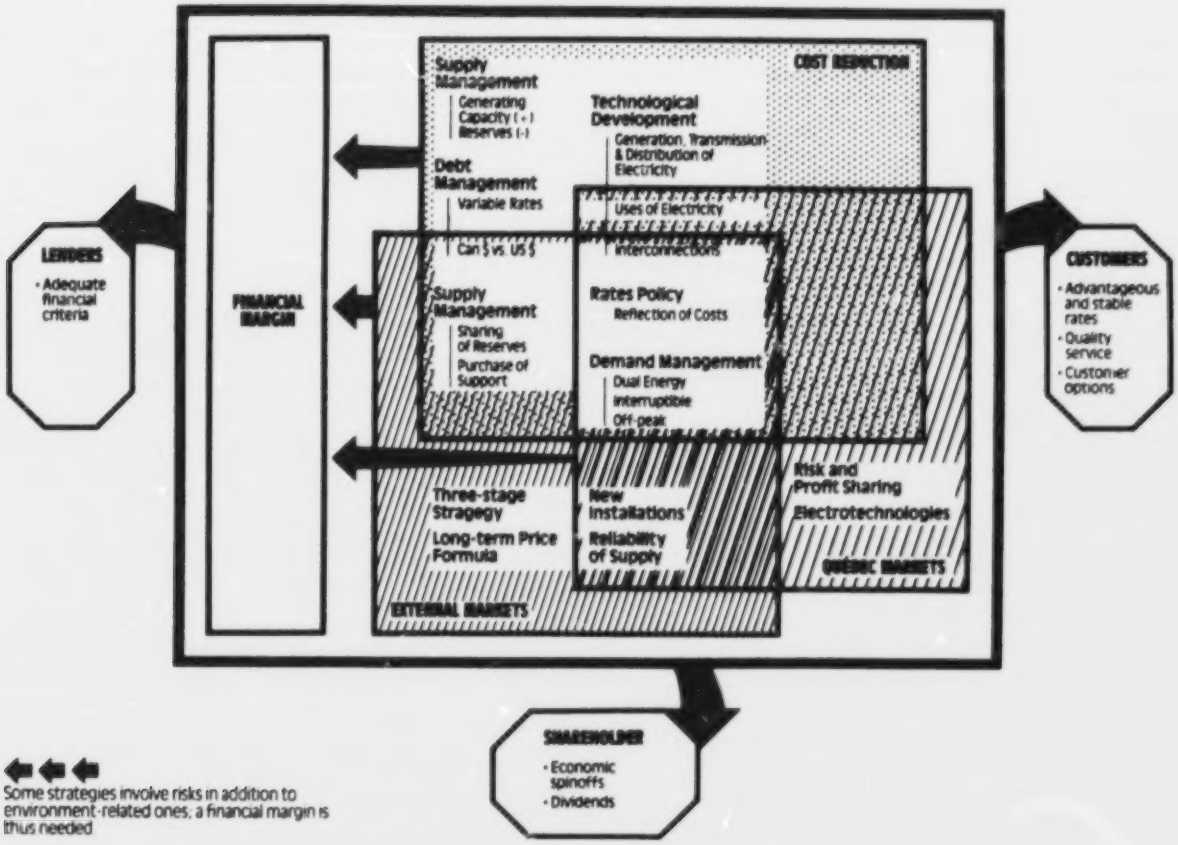
Figure 29 illustrates how the various Hydro-Québec strategies are arranged and complete each other to satisfy the company's three main concerns.

Some of Hydro-Québec's strategies address several concerns at once. This versatility appears very clearly in the case of the rate policy, load management and technological development, which respond to all the company's concerns. Rate policy and load management are central in that they promote efficient use of energy, which reduces the costs of supply not only for Québec consumption but also for developing exports, whose profitability is improved. Likewise, technological development strategies make it possible to reduce the costs of generating, transmitting and distributing electricity. They facilitate the development of Québec markets by preparing new uses of electricity and of external markets by improving the technology of interconnections.

Other versatile strategies also play a major role in Hydro-Québec planning. Since the Québec and external markets are supplied from the same system, the reliability of supply strategy affects them both. Likewise, certain external market development strategies assist in reducing costs. The increase in revenues from sales of electricity on American markets will allow a better balance between the needs for American currency for debt service and revenues in this currency, reducing the impact of the decline of the Canadian dollar on debt management. Likewise, interconnections with neighboring systems promote mutual assistance, allowing sharing of power reserves and, if needed, purchases of energy. These are both measures that can result in cost reductions.

Then there are the strategies related to a single concern but which generally contain various risks that require a financial margin. These are strategies allowing risk and profit sharing with customers that are heavy consumers of electricity and the promotion of electrotechnologies appropriate for the Québec market. There is also the three-stage export development strategy and the long-term price formula strategy, solely related to external market development. Finally, for cost reduction, there is the close management of supply, making it possible to increase output by hydroelectric installations, and the management of human, material and financial resources, which seeks to minimize the resources required for a given level of production.

Figure 29 - Links between Hydro-Québec's Strategies, Its Concerns and the Expectations of Its Partners



12.2 Nature of the Principal Tradeoffs of the Development Plan

The three main concerns of Hydro-Québec and the strategies that make them up are designed to satisfy the expectations of Hydro-Québec's various partners.

However, like any company pursuing a multi-faceted goal, Hydro-Québec must seek to achieve occasionally contradictory objectives. In such a decision-making framework, tradeoffs must be made to optimize particular strategies.

12.2.1 Rate Policy

The company's rate policy largely determines the degree to which the expectations of its partners can be satisfied. The rate policy is therefore at the heart of the tradeoffs in the Development Plan.

First, rate policy is the result of a compromise between the search for the best price signal to give to consumers to orient their choices and the company's efforts to keep rate increases as low as possible. Thus, for Québec markets, the rate policy recommended by Hydro-Québec will gradually reflect the cost price of all installations, rather than the higher cost of the latest or the newest facilities. In theory, the latter principle would lead to the optimum allocation of resources in the economy, to the extent that all other goods are priced at marginal cost.

Any new load will be supplied in the long term by new facilities whose costs are clearly higher than the average cost of existing plant, built many years ago. With average cost pricing, consumers are not fully conscious of the costs associated with satisfying an increase in their demand for electricity. The price signal is naturally even more distorted when the rate of one category of customers does not even reflect the cost price for this category and the shortfall is carried over to other consumers. Besides the lack of equity in such cross-subsidization, it stimulates demand in the preferentially treated rate category that increases the burden imposed on other consumers.

This concern is why, as part of a cost rate policy, Hydro-Québec is seeking to give a fair and equitable price signal to the extent it can. Thus, the rate policy is intended to gradually reflect the account costs of supply associated with various classes of customers. However, in order not to do harm to customer relations, the rate of catching up proposed in certain rate categories also reflects the constraints imposed by the changes in the prices of competing energies. Finally, although costs of supply differ from one region to another, Hydro-Québec intends to maintain uniform rates through its interconnected system, in order to promote regional development.

A second major tradeoff underlying rate policy concerns rate levels and their stability. Hydro-Québec customers want advantageous rates not only in the short term but in the long term as well. They also wish to obtain stable rates, i.e. to be sheltered from abrupt rate hikes. Hydro-Québec's rate of return requirement is the cornerstone of the tradeoffs between these different objectives.

It would be possible in the short term to maintain rates artificially low by dropping the requirement of a normal rate of return on capital for Hydro-Québec. However, capital is a scarce resource. Not assigning it an adequate value in rate policy would encourage inefficient use of electricity. It would then require more resources to satisfy the same fundamental needs of electricity consumers, when these same resources could be better used elsewhere in the economy. The reduced efficiency would result in higher unit costs of supply, not only to satisfy internal demand but also to develop exports, whose profitability would then decline. In fact, a short-term price decrease, achieved by dropping the requirement of a normal rate of return, would be a temporary, illusory advantage. Electricity bills would suffer from the effects of the inefficient use of the energy in the long term. Moreover, declining revenues and increasing unit supply costs would quickly reduce the margin of financial maneuver sought by Hydro-Québec. This would threaten the implementation of certain cost reduction strategies. Finally, the absence of the margin for maneuver would mean that Hydro-Québec could not absorb the changes of its economic and energy environment without resorting to sudden rate hikes in captive electricity markets undermining rate stability.

The rate of return requirement adopted for rates in Québec markets makes it possible to restore the desired margin of maneuver. It is a reasonable requirement that stands comparison with the lower end of rates of return granted to other public utilities. The gradual phasing-in of this rate of return reflects consumer ability to pay. In fact, application of the rate policy would bring the ratio of net earnings to electricity revenues in 1993 to only 18%, much lower than the 24% average maintained from 1963 to 1983.

Finally, the rate of return requirement makes it possible to make a third major tradeoff between the share of economic advantages of hydroelectricity, conveyed to customers through the rates, and the share conveyed to society as a whole, the owner of the resource, through dividends.

These two mechanisms are very different in their method of distributing the resource. Rates that are too low would give all the advantages of hydroelectricity according to current electric consumption. The largest consumers would necessarily receive the greatest benefits, which is hardly the most equitable form of distributing the advantages of a resource which is owned by all citizens. Furthermore, this mechanism would distort consumption of electricity and encourage inefficiency, counter to the interests of consumers and reducing the collective wealth. The rate of return requirement sought thus makes it possible to achieve a reasonable balance between the interests of customers and of society as a whole.

12.2.2 Québec and External Market Development Strategies

Hydro-Québec's role as a major lever of economic development implies that the company must actively seek profitable opportunities for developing markets in order to exploit Québec's hydroelectric resources.

A number of market development strategies recommended by Hydro-Québec call for tradeoffs between the risk to the company and the economic spinoffs associated with its activities. The strategy of risk and profit sharing contracts should promote industrial expansion and the associated economic spinoffs. This strategy seeks to let Québec profit from maximum economic development while attempting to recover average costs of supply, rather than share among other consumers of electricity the burden of the discounts traditionally offered to attract new industry. However, if the economic situation were unfavorable for several years, this strategy would mean a temporary decline in Hydro-Québec's rate of return.

The strategies focused on developing and demonstrating electrotechnologies also illustrate the tradeoff between the risk to the company and its concern for maximizing the economic spinoffs of its activities by promoting improvement in the productivity of its industrial customers.

Finally, the strategies concerning the penetration of external markets for sales of firm energy expose the company to risks different from those associated with sales of surplus energy. These involve the use of long-term price formulas and the possibility that the company will again find itself with energy surpluses when export contracts expire. On the other hand, the company should obtain major revenues from these exports after having moved ahead in time its capital expenditures and the economic spinoffs resulting from them.

Every company must take risks to grow. The tradeoff proposed by the Development Plan in this respect may prove eminently profitable on condition that the margin of financial maneuver is restored and the cost reduction strategies are implemented.

12.2.3 Cost Reduction Strategies

Cost reduction strategies established by Hydro-Québec will make a major contribution to creating in the long term the financial margin for maneuver the company needs to ensure rate stability while keeping Québec's hydroelectricity competitive. But these strategies will have an impact on the structure and size of the construction program and its economic spinoffs. At first glance, there must be some tradeoff between the interests of consumers of electricity, the main beneficiaries of the cost reductions, and the companies that participate in the construction of the company's installations.

However, if all the repercussions of these strategies are taken into account, the necessity of this tradeoff is more apparent than real. Achieving greater efficiency in managing hydroelectric resources assures Québec a more competitive position. This makes it possible to support the Québec and external market development strategies which themselves have economic spinoffs. Moreover, in an environment which is uncertain in both the short and long term, cost reduction strategies are the only way to ensure maintaining the comparative advantages of hydroelectricity. In any case, one of the main cost reduction strategies, load management, is itself a generator of economic spinoffs for Québec, both directly, in the installation of dual-energy systems, and indirectly, in the impact of discounts for interruptible loads on the development of interested industries, whose ability to compete internationally will be improved. Altogether, then, Québec is assured of major economic spinoffs from the cost-reduction strategies devised by Hydro-Québec.

12.2.4 Quality of Service

Finally, Hydro-Québec will seek to reduce the number and duration of service interruptions by strengthening the reliability of its system. The economic impacts of these interruptions of service justify investments by Hydro-Québec in improving its system. However, these investments will have an impact on the company's cost price and therefore on rates. The productivity of these investments decreases the more that are made, so there must be a tradeoff between improving quality of service and the price a customer is disposed to pay.

12.2.5 In Summary

All the strategies adopted result from tradeoffs Hydro-Québec has made after carefully listening to its partners. It must attempt to satisfy their short, medium and long term expectations and resolve as best it can the conflicts that may arise between private and public interests, between immediate and future benefits, and between lower and less risky earnings and higher and riskier profits.

The merits of the strategies of this plan can also be judged by their impacts on its partners, measured in relation to the dual role played by Hydro-Québec as public utility and promoter of economic development.

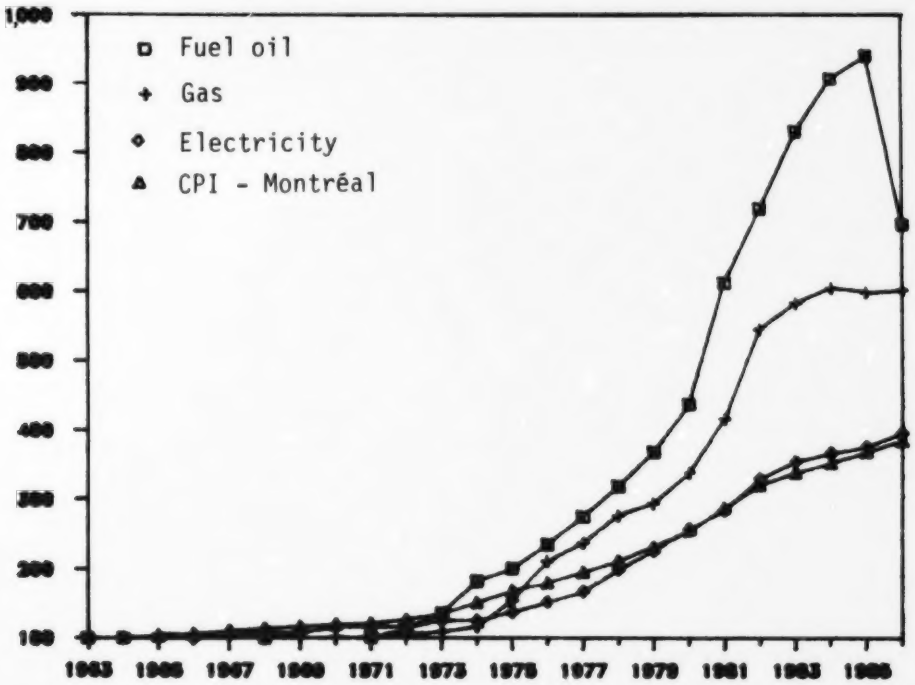
12.3 Hydro-Québec as a Public Utility

The prime reason for Hydro-Québec to exist is its responsibilities as a public utility. This role has a number of dimensions to which the strategies of the company correspond. In particular, Hydro-Québec must respond to the fundamental concerns of its clientele concerning the level of rates and their stability. Furthermore, this clientele is entitled to expect quality service and a range of products adapted to their specific needs in order to be able to optimize purchases of electricity and profit from a quality environment. The tradeoffs made respond to these expectations.

12.3.1 Advantageous, Stable and Fair Rates

Figure 30 shows the history of electricity, oil and natural gas prices and that of general inflation. The 1963-1975 period showed growth in rates below that of general inflation, while during the 1975-1983 period, years of intensive construction at the La Grande Complex, rate increases outpaced inflation by an average of a little more than 3% per year. However, overall, it is clear that Québec customers have been favored by modest rate increases comparable to the general price index and lower than the hikes in the prices of other forms of energy. More recently, in 1984 and 1985, competition in the energy sector and the economic slowdown made Hydro-Québec apply increases that were substantially lower than inflation. This compensates for the fact that in 1986, because its margin for maneuver has been exhausted, the company was obliged to increase its rates more than inflation.

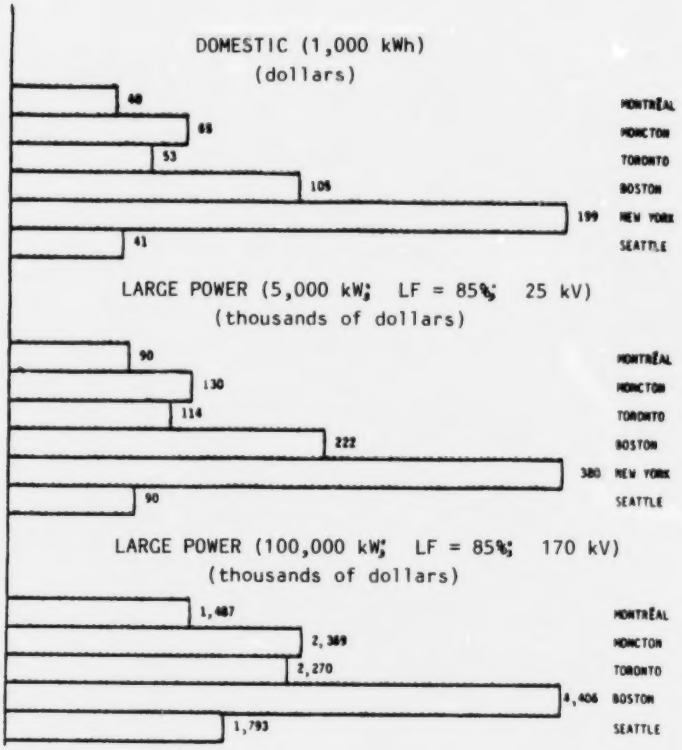
Figure 30 - **Inflation and Changes in Energy Prices**
(1963 = 100)



This good historical performance has allowed Hydro-Québec to maintain an enviable competitive position, compared to a number of major North American cities. For example, if residential customers were billed as in Toronto, they would be paying 33% more for electricity. The difference is as much as 50% in the case of some industries.

This advantage has been shared by all customers of the interconnected system since nationalization. To promote regional development, Hydro-Québec has always sought territorial uniformity in its rates. The company will also continue to give its support to energy improvement programs for the isolated systems. These programs contribute to reducing costs for Hydro-Québec and customers in satisfying the energy needs of these systems.

Figure 31 - **Comparative Monthly Bills**
March 1986



* Not including sales tax.

Hydro-Québec is convinced that the benefit obtained by the people of Québec from the presence of major hydroelectric resources on its territory is a heritage that must be preserved. The Development Plan offers two major forms of intervention in this area: the cost reduction strategy and the restoration of the financial margin for maneuver.

In the short term, achieving the minimum financial criteria will require average rate increases slightly above inflation. However, because of the various strategies of the plan, the application of the rate policy should not require increases exceeding general inflation on average in the long term, while the margin for maneuver it will create should allow stability to be assured, despite the many risks the company must face.

This long-term perspective for Québec's electricity rates is particularly interesting when it is compared to the very high level of uncertainty affecting the future of the prices of competing energies.

The goal of Hydro-Québec's rate policy is to gradually reduce the gap between rates and the costs of supplying various products. This objective is shared by most public utilities, whether regulated or not. In fact, equity in the treatment of various categories requires that the prices of similar products tend to become uniform. As noted, the rate of adjustment of rate structures will in any case be spread over a long period and will be modulated by the constraints imposed by the prices of competing energies.

12.3.2 Diversified Products and Quality Service

The Québec market development strategies are based on diversified products, adapted to specific needs of different customers. These allow customers to optimize their electricity costs and, in the case of industries, improve their productivity and thereby their ability to compete on international markets. The products include the various dual-energy programs, off-peak usage, interruptible power and the industrial electrotechnologies program.

It is difficult to make systematic international comparisons with respect to diversity of products offered. Nevertheless, few countries seem to have available as large a level of loads which can be interrupted in peak periods as Hydro-Québec and provide all customers with reduced supply costs.

Furthermore, the measures taken to increase reliability of electricity supply will have substantial impacts in the medium term. For example, enhancing transmission system design criteria will reduce the likelihood of general power failures between now and the early 1990s.

Likewise, Hydro-Québec's concerns about quality of service subsume its concern for maintaining and improving the quality of the environment. As a public utility, the company is seeking not only to reduce the environmental impact of its activities but also to take the expectations and activities of other users of environmental resources into account. In this perspective, since 1985, municipalities whose territory is affected by new construction projects can undertake environmental enhancement projects with funding from Hydro-Québec.

In 1985, the company also signed an agreement with the Union des producteurs agricoles (UPA - Farm Producers' Union) on the design, construction and operation of facilities in agricultural and forest areas. Finally, a $112 million agreement has been signed by Hydro-Québec, SEBJ and the Cree in order to promote the economic development of the Cree and protect their way of life. An agreement on the management of problems associated with the presence of mercury in the regions used by the Cree was also signed by the same parties plus the government of Québec.

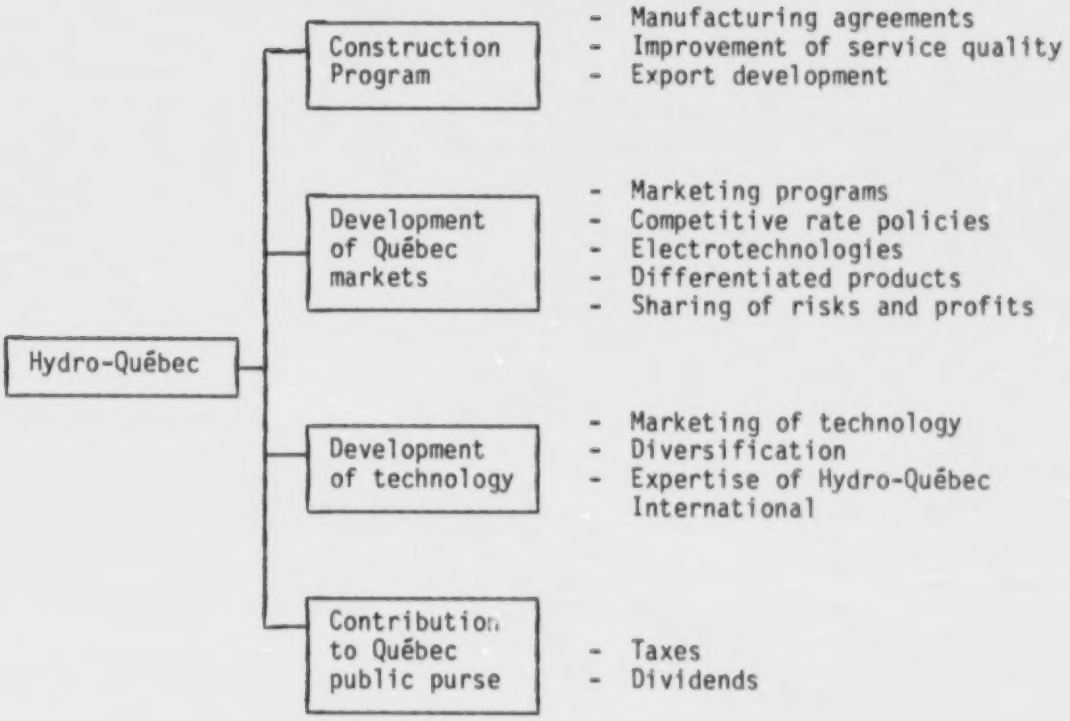
12.4 Hydro-Québec as Locomotive of Economic Growth and Development

One of the factors underlying Québec's participation in technological and economic progress is its ability to react to the growing competitiveness of the international environment and the rising standards of productivity and efficiency. In this arena, Hydro-Québec intends to play a role that substantially exceeds its traditional and highly visible contribution as builder of large hydroelectric projects. Many of the strategies of the Development Plan will promote improvement in the competitive ability of the Québec economy.

In coming years, Québec manpower will have numerous opportunities for employment, thanks to a construction program focusing on more job creating activities such as investments in system improvement. Moreover, a new generation of marketing programs, based on electrotechnologies, product differentiation and better adapted rate formulas, will take over from the marketing programs for surplus power. This will assure Québec large and permanent participation in the development of sectors that are heavy users of electricity. Moreover, the investments made by Hydro-Québec to develop new activities related to the energy sector based on its technical expertise will contribute to enhancing the role of engine of the Québec economy that is incumbent on the company, while ensuring its own growth.

Likewise in the long term, the general competitive ability of the Québec economy and its employment levels will benefit substantially from the dividends arising from the financial margin created by Hydro-Québec activities in the 1990s that can be used to lighten the tax burden or stimulate the economy.

Table 31 - **Hydro-Québec's Development Levers and Job Creation**



12.4.1 Impact of Electricity Generation and Distribution Activities

Major economic spinoffs will result from the execution of the construction program. More than $7.6 billion will be invested over the next three years. In view of the manpower volume of these activities, this program should allow Hydro-Québec to maintain a staff under the capital expenditures and operations budgets of about 22,000 permanent and temporary employees. This is in addition to supporting on average more than 23,000 jobs among outside firms asked to execute some of the construction program and among suppliers of goods and services established in Québec. Moreover, the growth of the investment program will offset, in terms of job creation, the withdrawal of the surplus disposal marketing program. All together, some 60,000 person-years of work will be supported annually by Hydro-Québec activities during the period from 1987 to 1989.

Table 32 - Jobs Supported by Hydro-Québec (in person-years)

	Historical		Estimate	Forecast		
	1984	1985	1986	1987	1988	1989
GENERATION AND DISTRIBUTION OF ELECTRICITY	38,655	39,535	36,930	39,875	46,825	48,315
Jobs related to operations	20,325	20,710	19,880	20,160	20,990	21,225
- Direct	15,185	15,850	15,140	15,535	16,160	16,395
- Indirect	5,140	4,860	4,740	4,625	4,830	4,830
Jobs related to capital investments	18,330	18,825	17,050	19,715	25,835	27,090
- Direct	9,170	9,740	8,875	9,950	12,140	12,690
- Indirect	9,160	9,085	8,175	9,765	13,695	14,400
MARKETING OF ELECTRICITY *	23,590	21,230	21,230	17,920	13,195	10,735
Jobs related to marketing programs	16,175	8,840	9,855	8,145	3,210	1,000
- Dual energy	980	1,755	1,285	195	70	70
- Electrotechnologies	-	255	570	815	880	930
- Rate discount program	13,140	5,995	7,820	7,070	2,260	-
- Other programs	2,055	835	345	65	-	-
Jobs related to measures promoting industries that are heavy users of electricity	7,415	12,390	11,210	9,775	9,985	9,735
Total	62,245	60,765	58,160	57,795	60,020	59,050

* Revised figures for 1984 and 1985.

In the longer term, the target scenario adopted by Hydro-Québec can be characterized by annual average investments of the order of $4.2 billion for the 1990-1996 period. These capital expenditures arise directly from the various strategies recommended by Hydro-Québec to ensure the development of Québec and external markets.

The execution of this capital investment program should ensure significant participation by Hydro-Québec in job creation, especially since using more efficient procurement procedures, such as pre-procurement studies, will promote greater participation by companies with greater Québec content.

Furthermore, Hydro-Québec expects to optimize the economic spinoffs of its activities as an electricity producer and distributor by seeking forms of intervention have more structuring effects on the economy than the creation of temporary construction jobs. Thus, new supply strategies involving fabrication agreements will help ensure a presence by Québec industry in sectors previously absent from Québec's economic structure or the survival of companies threatened with disappearance. Thus, the fabrication agreements that Hydro-Québec has made for disconnecting switches, circuit breakers, fuses and lightning arresters have contributed to enhancing Québec participation in the company's electrical distribution activities. Moreover, these agreements aid Québec's technological development by stimulating research and development activities carried out by Hydro-Québec's industrial partners. These strategies will also have substantial impacts on employment by promoting the expansion into Québec of manufacturing companies with an international market for their products.

12.4.2 Impact of Marketing Electricity

The marketing strategies introduced in recent years by Hydro-Québec will be very effective because in addition to allowing the disposal of surpluses of energy or promoting the off-peak consumption that is less expensive for Hydro-Québec, they have turned out to be powerful levers of economic development. Every dollar invested by Hydro-Québec in these programs has resulted in major additional investments by its customers, whether in the form of plant as part of the rate reduction program or the purchase of equipment for the industrial boiler or dual-energy programs. The majority of the industrial sectors, but especially pulp and paper, petroleum products, chemicals and primary metal processing, have benefited from Hydro-Québec's marketing programs to accelerate their modernization or expansion. These programs have thus offset the loss of jobs resulting from the slowdown in the construction program in recent years.

However, the period of surplus disposal programs is over. This means that there must be a realignment of strategies towards sectors that are heavy consumers of electricity, where the lever effect is of more significance.

Table 33 - Québec Industries with High Consumption of Electricity

Industries	Electrical intensity* (in %)
Iron mining	4.0
Pulp and paper mills	6.5
Steelmaking	4.0
Copper smelting and refining	9.1
Aluminium smelting and refining	15.0
Cement manufacturing	5.3
Abrasive manufacturing	19.8
Plastic and synthetic resin manufacturing	1.5
Industrial inorganic chemicals	11.7
Entire manufacturing sector	1.0

* Electricity purchased in 1980 over gross production.

An increase factor was used to integrate self-generation in the evaluation of the electrical intensity of the aluminun, pulp and paper and chemical industries.

The new generation of Hydro-Québec marketing programs is thus oriented toward sectors that are sensitive to the advantages of electricity. Historically, major industries have been attracted to Québec by the natural attributes of hydroelectricity. These industries have been able to substantially improve their competitive position and domestic and foreign market penetration by making maximum use of the price advantages conferred by this resource. In the last analysis, this has meant more investments, more exports of manufactured products and more jobs for Québec. In this respect, it is interesting to note that three of the industries that are the heaviest consumers of electricity: pulp and paper, primary metals and chemicals, account for nearly one third of manufacturing shipments outside Québec and involve more than 20% of employment in the manufacturing sector.

The table below ranks the monetary advantages that Hydro-Québec's rate structure offers its industrial customers by simulating the overall electricity bills that would apply according to the rate structures in effect in the various neighboring systems.

Table 34 - **Rate Advantages obtained by Hydro-Québec Customers for Its Industrial Customers in 1986**
(In Millions of Current Dollars)

Neighboring Systems	Total electric bill according to the rate structure*	Estimated advantages
Hydro-Québec	850	---
Toronto	1,100	250
Moncton	1,200	350
Boston	2,100	1,250
New York	3,500	2,650

* Total expenditures by Québec industrial customers, assuming application of rate scales in effect in various cities.

It is therefore important to maintain the rate advantages that industrial customers of Hydro-Québec have obtained by being in Québec. The company's strategies preserve this competitive advantage while controlling costs of supply, assuring stability and equity of rates and applying a rate policy which should not imply long-term increases above inflation on average.

Furthermore, in recent years, the international trade environment has undergone major changes. New products will be offered to customers in order to retain or improve Hydro-Québec's competitive position in industrial expansion. In this respect, marketing actions planned will ensure a permanent replacement for the surplus disposal programs in terms of job creation.

In addition to being able to count on what are some of the most advantageous rates in the world, companies that wish to open plants in Québec will be able to profit from more diversified products, because of the improvements in the interruptible power program, and reduce their comparative risks by negotiating long-term contracts based on risk and profit sharing. This has been the case of Norsk Hydro and QIT.

Another aspect that Hydro-Québec is promoting is electrotechnologies. The company has committed nearly $12 million to industrial applications of electricity that increase the penetration of electricity in certain industrial branches, especially pulp and paper. Six projects are now under study in association with industrial partners, and the opening of the electrochemistry and electrotechnologies laboratory in Shawinigan should promote a multiplication of such applications. The penetration of electrotechnologies will play a role in the industrialization of Québec, while helping develop an expertise in the use of electricity that has some potential for export. The electrotechnologies program will also provide a major and ongoing replacement for the industrial boilers program by affecting the energy efficiency of the whole production process.

The establishment of industries that are heavy users of electricity represents a major economic challenge for Québec. In this area alone, nearly 10,000 person-years of work will be created annually in these sectors over the next three years, more than three quarters of them permanent jobs. Moreover, as illustrated by Norsk Hydro, Hydro-Québec's policies strengthen Québec's industrial base by stimulating the emergence of new sectors of activity and the creation of skilled jobs.

12.4.3 Impact of Technology Marketing and Diversification

The economic growth of Québec is based on its ability to meet the technological challenge. The jobs of the future will depend on it. Hydro-Québec recognizes the importance of technological development and intends to assume leadership in this field by involving its resources and expertise. Among the methods of action Hydro-Québec intends to emphasize are the creation of companies in the technological sectors and the maximum exploitation of its technical expertise.

12.4.3.1 Marketing of the Company's Technology

An important lever used by Hydro-Québec to promote greater Québec participation in marketing technologies developed by the company to satisfy its own needs is to grant Québec companies manufacturing licenses for these products. Sales of more than $7 million have resulted from the exploitation of Hydro-Québec patents in 1986, and strong growth in this area is expected in coming years.

Moreover, small companies that specialize in high technology sectors have also benefited from financial and technical support from Hydro-Québec to develop expertise that can be exported internationally. This has happened with Cyme International for software for electric system analysis and with Vibro-meter for air-gap measurement devices.

12.4.3.2 Impact of Diversification

Parallel to the development of the company's technology, Hydro-Québec is seeking to profit from its expertise and resources by promoting the emergence of projects or companies in fields associated with energy.

This commitment has taken the form of the takeover of Nouveler Inc., which is now the preferred vehicle by Hydro-Québec for structuring its diversification efforts. Nouveler has contributed to the development of companies manufacturing heating equipment, recently combined in Venmar Inc. to allow public financing through stock. The new company specializes in making integrated heat-ventilation-air conditioning systems, has more than 450 employees and sales of more than $30 million in 1986. Éconoler Inc. is another major development project, making turnkey energy conservation installations. This company has carried out more than 650 projects in Québec since 1981, with sales of $75 million and annual savings of $25 million for its customers. Based on these achievements, Éconoler is pursuing its expansion on international markets in the United States, Europe and Asia. Nouveler is also active in a number of other small companies employing a total of more than one hundred people.

12.4.3.3 International Activity by Hydro-Québec

Traditionally, Hydro-Québec has sought to optimize its structuring effects on the economy by assuring the collaboration of local companies in the design, construction and supply of its equipment. This is in order to develop acknowledged expertise in Québec that can be exported internationally. The success of some Québec firms on international markets is due in part to their participation in the development of Québec's hydroelectric potential, both for services and construction and the supply of equipment.

This is the orientation Hydro-Québec International intends to pursue. It generally uses the distinctive technical expertise of the company in association with Canadian partners in the execution of international projects involving assistance, design and installation of projects associated with electricity. The example of China illustrates the capacity of Canadian consortiums to obtain contracts on the most competitive markets. The active presence of Hydro-Québec International on foreign markets in coming years should significantly increase the contribution of Québec companies to the supply of services and equipment to international projects. In 1986, Hydro-Québec International posted sales of $15 million.

Moreover, it should be noted that international activity stimulates self-criticism within the company, allowing comparisons of its technologies with those offered by others internationally. This is a by no means insignificant contribution to the development of Québec.

12.4.4 Hydro-Québec's Contribution to Québec Government Revenues

Another way for Hydro-Québec to enhance the competitive ability of Québec is to provide the government with revenues, enabling a corresponding reduction in the tax burden of Québec citizens. Moreover, at a time when governments are concerned with the effectiveness of their tax system, obtaining a financial margin from a rate policy based on a requirement of a normal rate of return, complying with the costs and risks assumed by Hydro-Québec, promotes a more competitive and more efficient tax policy. This in turn guarantees a more productive economy.

Because of the shocks that Hydro-Québec has absorbed in recent years, no dividends have been paid since 1984. The current tax contribution of Hydro-Québec is essentially the general tax on capital to which Québec corporations are subject and a tax on revenues from its sales of electricity, in lieu of property taxes. Approximately $300 million will be paid annually to the government in 1987 and 1988. In the not too distant future, however, Hydro-Québec's contribution will take the form of dividends that will result directly from the rate of return and financial margin requirements the company must restore, in order to absorb the risks inherent in the economic and energy environments of the 1990s.

Table 35 - **Direct Contributions by Hydro-Québec to Québec Government Revenues**
(In Millions of Current Dollars)

	Historical		Estimate	Forecast		
	1984	1985	1986	1987	1988	1989
Taxes	224	246	272	294	312	331
Dividends	156	0	0	0	0	292
Total	380	246	272	294	312	623

13. CONCLUSION

Hydro-Québec presents a Development Plan that, while satisfying the electricity needs of Québec customers at advantageous prices, stresses the exploitation of hydroelectricity.

Beyond pursuing the activities begun in recent years, this plan describes the company's long-term development options within the framework of several scenarios of growth on Québec and external markets.

The long-term development options will be implemented as the strategies proposed in this Development Plan are put into practice.

The overall strategy is based on supply optimization and load management integrated with energy marketing activities that are harmonized with pricing, quality of service and resource management policies intended to satisfy the expectations of the company's various partners. This is a strategy which, supported by dynamic technological development, enables Hydro-Québec to fulfil its role as a public utility and amplify its role as instrument of economic development.

Because of its scope and its views, the plan represents a challenge to the company. However, for the management and all employees of Hydro-Québec, it is a challenge whose achievement represents opportunities with doint rewarding work with an attractive career potential.